REED CREEK WATERSHED TMDL IMPLEMENTATION PLAN TECHNICAL REPORT

Submitted to:

The Stakeholders of the Reed Creek Watershed

In Cooperation With:

Virginia Tech Department of Biological Systems Engineering
Center for Watershed Studies,

Virginia Department of Environmental Quality,

and

Virginia Department of Conservation and Recreation

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LIST OF ABBREVIATIONS

The following abbreviations are used throughout this document. To better aid the reader in comprehension of the document each abbreviation is defined here.

BMP – Best Management Practice
BSE – Biological Systems Engineering Department (Virginia Tech)
CPP – Continuing Planning Process
CREP – Conservation Reserve Enhancement Program
CRP- Conservation Reserve Program
CWA – Clean Water Act, the origin of the Total Maximum Daily Load Program
CWSRF – Clean Water State Revolving Fund
EQIP – Environmental Quality Incentives Program
FTE – Full Time Equivalent
HSPF – Hydrological Simulation Program-FORTRAN
IP – Implementation Plan
LA – Load Allocation, the load allocated to nonpoint and background sources in the Total Maximum Daily Load Study
LIP – Landowner Incentive Program
MOS – Margin of Safety, a load that represents uncertainty in the modeling process
NPS – nonpoint source, referring to diffuse sources of pollution, such as from runoff
NRCS – Natural Resources Conservation Service
SWCB – State Water Control Board
SWCD –Soil and Water Conservation District
TMDL – Total Maximum Daily Load (Study)
USEPA – United States Environmental Protection Agency
VAC – Virginia Administrative Code
VCE – Virginia Cooperative Extension
VADCR – Virginia Department of Conservation and Recreation
VADEQ – Virginia Department of Environmental Quality
VDH – Virginia Department of Health
VDOF – Virginia Department of Forestry
VDOT – Virginia Department of Transportation
VPDES – Virginia Pollutant Detection and Elimination System
VT – Virginia Tech
WLA – Waste Load Allocation, the load allocated to point sources
WQIF – Water Quality Improvement Fund
WQMIRA – Water Quality Monitoring, Information and Restoration Act

EXECUTIVE SUMMARY

The Reed Creek watershed is located within Wythe County. A segment of Reed Creek extending from the Pine Run confluence to the Venrick Run confluence was first listed as impaired in 2002 due to water quality violations of the fecal coliform standard. Another segment of Reed Creek, extending from the Glade Creek confluence to the confluence with the New River, was listed as impaired in 2004 due to water quality violations of the *E. coli* standard. Additional segments of Reed Creek (Guillion Fork to South Fork Reed Creek, Muskrat Creek to Miller Creek, and Beaverdam Creek to Glade Creek) were listed in 2006. South Fork Reed Creek, Mill Creek, Stony Fork, Tate Run, Cove Creek, and Miller Creek, all tributaries in the Reed Creek watershed were also listed as impaired in 2006 due to water quality violations of the *E. coli* standard.

When streams fail to meet standards they are placed on the state's impaired waters list, and the state must then develop a Total Maximum Daily Load (TMDL) for the pollutant. A TMDL study was completed for Reed Creek and its tributaries in 2012. After a TMDL is developed for an impaired water, an Implementation Plan (IP) must be developed and implemented with the goal of meeting the water quality standards for the water body. The purpose of this IP is to describe the implementation actions that will achieve the water quality goals in the Reed Creek watershed.

Review of the TMDL Study

The Reed Creek watershed is approximately 173,828 acres and is part of the New River Basin. The predominant land use in the Reed Creek watershed is forest (52%), with additional significant areas in pasture and hay land (38%); less significant land uses are residential (8%) and cropland (2%). Potential nonpoint sources of bacteria considered during TMDL development include failing septic systems and straight pipes, domestic pets, livestock, and wildlife. The primary sources of bacteria were identified as direct deposition of fecal matter in streams by livestock and wildlife, and surface runoff from pasture during storm events.

Various pollutant reduction scenarios were evaluated to meet the state 30-day geometric mean water quality standard for *E. coli* (126 cfu/100 mL). The Reed Creek TMDLs call for reductions from agricultural and residential sources; and for three impaired stream segments, wildlife reductions are also needed to meet the TMDLs. The final allocation scenarios for each watershed are shown in Table ES-1.

Table ES-1. Final pollutant source reduction scenarios for the Reed Creek watershed.

Impaired Segment	Cattle Direct Deposit	Loads from Cropland	Loads from Pasture	Straight Pipes	Loads from Residential		Wildlife Direct Deposit
					Failing Septic Systems	Pets and Wildlife	
Mill Creek	100	0	85	100	100	0	20
Cove Creek	100	0	0	100	100	0	0
Miller Creek	100	0	0	100	100	0	0
Stony Fork	100	0	90	100	100	0	15
Tate Run	100	0	95	100	100	0	10
S Fork Reed Creek	100	0	55	100	100	0	0
Reed Creek (headwaters to Stony Fork)	90	0	0	100	100	0	0
Reed Creek (Stony Fork to South Fork Reed Creek)	65	0	0	100	100	0	0
Reed Creek (South Fork Reed Creek to New River)	15	0	0	100	100	0	0

Implementation Actions

Potential control measures, their costs, and pollutant removal effectiveness estimates were identified through a review of the Reed Creek TMDL report, through input from the TMDL IP Work Groups, from a literature review, and from modeling. Because the Reed Creek watershed contains a combination of agricultural and residential land uses, implementation actions to address the required pollutant reductions include a variety of control measures which target each pollutant source.

The quantity of corrective measures, or implementation actions, needed to meet the source load reductions was determined through spatial analysis and the model used in the TMDL study. The recommended agricultural and residential management practices needed to attain the Stage 1 goal and remove the impaired stream segments from the state's impaired waters list are

- install 115 miles of livestock exclusion fencing,
- install 402 livestock exclusion systems,
- implement 3,100 acres of improved pasture management,

- identify and replace 43 straight pipes with approved on-site sewage disposal systems,
- repair or replace 1,071 failing septic systems.

Associated costs for each implementation action were estimated from the Virginia Department of Conservation and Recreation (VADCR) agricultural BMP database, from TMDL IPs in neighboring counties, and from discussions with Big Walker Soil and Water Conservation District (SWCD). The total cost for Stage 1 (de-listing the streams from the impaired waters list) implementation, including technical assistance, is $17,144,000.

Measurable Goals and Milestones

The goals of TMDL implementation are to restore the water quality in the impaired stream segments in the Reed Creek watersheds so that they comply with water quality standards and to de-list these segments from the Commonwealth of Virginia's 303(d) List of Impaired Waters. Progress towards these goals can be assessed during the implementation process by tracking the number/type of control measures that are installed and programs or policies developed and executed (implementation actions) and continued water quality monitoring. Improvements in water quality will be measured through monitoring of bacteria concentrations throughout the watersheds.

The implementation of control measures will be accomplished in stages. This staged approach is based on meeting water quality goals over a fifteen-year period. Implementation during Stage 1 (years one through ten) focuses on installing livestock exclusion systems, improving pasture management, removing straight pipes, and repairing or replacing failing septic systems. Voluntary implementation of Stage 1 control measures is expected to reduce the bacteria loadings from controllable sources so that the impaired stream segments can be removed from the state's impaired waters list. The next 5 years of the 15 year implementation period are defined as Stage 2. If needed, the remaining control measures will be installed during Stage 2 (years eleven through fifteen) to continue toward the reductions needed to meet the TMDLs.

Stakeholders' Roles and Responsibilities

Stakeholders are individuals who live or have land management responsibilities in the watershed, including government agencies, businesses, private individuals, and special interest groups. Stakeholder participation and support is essential for achieving the goals of this TMDL effort (i.e., improving water quality and removing streams from the impaired waters list).

The Big Walker SWCD will provide cost-share funds, lead education and technical efforts, and track the agricultural and residential implementation practices. The USDA Natural Resources Conservation Service (NRCS) will also assist private landowners by providing funding through federal programs and offering technical assistance with installation of implementation practices.

The Virginia Department of Environmental Quality (VADEQ) is the lead state agency in the TMDL process. VADEQ will monitor eleven locations in the watersheds to evaluate the water quality throughout the implementation period.

While successful implementation depends on stakeholders taking responsibility for their role in the process, the primary role falls on the local groups that are most affected; that is, businesses, community watershed groups, and citizens within the watershed. Local community watershed groups (for example, Beagle Ridge chapter of the Virginia Master Naturalists, New River Watershed Roundtable, Inc., Friends of the New River, New River Valley Sierra Club) have a valuable knowledge of the local watershed and river habitat that is important to the implementation process. Active community watershed groups can be a good resource for procuring and distributing grant funds to assist in financing implementation actions. Depending on their missions, they also present opportunities for educating residents and other stakeholders about the TMDL and implementation plan.

Potential Funding Sources

Funding sources that may be available to support implementation include:

- Clean Water State Revolving Fund
- Conservation Reserve Enhancement Program
- Environmental Quality Incentives Program
- EPA Section 319 Grant Incremental Funds
- Landowner Incentive Program (Non-Tribal)
- National Fish and Wildlife Foundation
- Southeast Rural Community Assistance Project
- Virginia Aquatic Resources Trust Fund
- Virginia Agricultural Best Management Practices Cost-Share Program
- Virginia Agricultural Best Management Practices Loan Program
- Virginia Agricultural Best Management Practices Tax Credit Program
- Virginia Environmental Endowment
- Virginia Open-Space Lands Preservation Trust Fund

- Virginia Small Business Environmental Assistance Fund Loan Program
- Virginia Water Quality Improvement Fund
- Wildlife Habitat Incentive Program
- Wetland and Stream Mitigation Banking
- Wetland Reserve Program

1. INTRODUCTION

1.1. Background

In 1972, the US Congress enacted the Federal Water Pollution Control Act known as the "Clean Water Act" (CWA). The founding objective of that legislation is well defined in its opening paragraph,

"to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."

The legislation covers a range of water quality efforts aimed at reaching this objective. Immediately relevant to this project are the requirements that states develop and promulgate water quality standards for waters within their jurisdictions. In section 303(d) of the Act, the federal government requires states to identify those water bodies not meeting the published water quality standards for any given pollutant. This list is often called the "303(d) list" or the "impaired waters list." Virginia's first impaired waters list was published and reported to the United States Environmental Protection Agency (USEPA) in 1994. Recently, the 303(d) list has been combined with the 305(b) water quality assessment report which describes the overall quality of a state's waters. Virginia publishes and submits this "305(b)/303(d) Integrated Report" to USEPA every two years.

Section 303(d) requires that, if a particular water body is listed as "impaired," the state must develop a "total maximum daily load" for any pollutant that exceeds water quality standards in that water body. The "total maximum daily load" or TMDL is essentially a "water pollution budget." A TMDL study defines the maximum amount of pollutant each source in the watershed can contribute to the water body, so that the water body remains in compliance with applicable water quality standards.

Virginia's 1997 Water Quality Monitoring, Information and Restoration Act states in section 62.1-44.19:7 that the "Board shall develop and implement a plan to achieve fully supporting status for impaired waters." This means that after a TMDL is developed for an impaired water, an Implementation Plan (IP) must be developed and implemented with the goal of meeting the water quality standards for the water body. The purpose of the IP presented in this document is to characterize implementation actions that will achieve the water quality goals in the Reed Creek watershed.

1.2. Designated Use and the Applicable Water Quality Standard

According to 9 VAC 25-260-5 of Virginia's State Water Control Board Water Quality Standards, the term 'water quality standards' means

> *"…provisions of state or federal law which consist of a designated use or uses for the waters of the Commonwealth and water quality criteria for such waters based upon such uses. Water quality standards are to protect the public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law and the federal Clean Water Act."*

The 'Designation of Uses' of all waters in Virginia is defined in the Code of Virginia (9 VAC 25-260-10) (SWCB, 2011):

> *All state waters, including wetlands, are designated for the following uses: recreational uses, e.g. swimming and boating; the propagation and growth of a balanced indigenous population of aquatic life, including game fish, which might reasonably be expected to inhabit them; wildlife; and the production of edible and marketable natural resources, e.g., fish and shellfish.*

The applicable water quality criteria for fecal bacteria impairments are contained in Section 9 VAC 25-260-170. At the time the stream segments in the Reed Creek watershed were first placed on the 303(d) list, the criteria for bacteria included two parts: (1) the *Escherichia coli* (*E. coli*) bacteria concentrations for fresh water shall not exceed a geometric mean of 126 colony forming units (cfu) per 100 mL of water, and (2) the *E. coli* concentrations for freshwater shall not exceed 235 cfu per 100 mL at any time (single-sample criteria). If the water body exceeds the single sample maximum more than 10.5% of the time, the water body is classified as impaired and a TMDL must be developed and implemented to bring the water body into compliance with the water quality standard. If the sampling frequency is one sample or less per 30 days, the single-sample criterion is applied; for a greater sampling frequency, the geometric mean criterion is applied. Most of the ambient water quality monitoring conducted by VADEQ is done on a monthly or bimonthly basis. This sampling frequency does not provide the two or more samples within 30 days needed for use of the geometric mean part of the standard. Therefore, VADEQ used the 235 per 100 mL part of the standard in the assessment of the *E. coli* bacteria monitoring data.

The current bacteria standard for freshwater streams in Virginia declares that *E. coli* bacteria concentrations for freshwater shall not exceed a monthly geometric mean of 126 cfu per 100 mL. To ensure compliance with the standard, the bacteria TMDLs for the impaired stream segments of the Reed Creek watershed were developed to meet this *E. coli* criterion.

2. STATE AND FEDERAL REQUIREMENTS FOR TMDL IMPLEMENTATION PLANS

2.1. Background

Once a water body is listed as impaired and a subsequent TMDL study has been conducted, then the state, in conjunction with watershed stakeholders, must develop and implement a strategy that will limit the pollutant loadings to those levels allocated in the TMDL. Such a strategy, also known as an Implementation Plan (IP), must contain corrective actions that when implemented will reduce pollutant loadings to bring the water body into compliance with the relevant standard(s).

2.2. State Requirements

The State's Water Quality Monitoring, Information and Restoration Act (WQMIRA) directs the VADEQ to "develop and implement a plan to achieve fully supporting status for impaired waters." In order for an IP to be approved by the State Water Control Board, the IP must include the following required components, as outlined in WQMIRA:

- date of expected achievement of water quality objectives;
- measurable goals;
- necessary corrective actions; and
- associated costs, benefits, and environmental impact of addressing the impairment.

2.3. Federal Recommendations

Section 303(d) of the CWA and current USEPA regulations do not require the development of implementation strategies, though their guidance clearly describes this as the next step leading to the attainment of water quality objectives. In its 1999 "Guidance for Water Quality-Based Decisions: The TMDL Process," USEPA recommends the following minimum elements for an approvable IP:

- a description of the implementation actions and management measures;
- a time line for implementing these measures;
- legal or regulatory controls;
- the time required to attain water quality standards; and
- a monitoring plan and milestones for attaining water quality standards.

These recommendations closely track the State's WQMIRA requirements.

2.4. Requirements for Section 319 Fund Eligibility

Beyond the regulatory requirements listed above, the CWA was amended in 1987 to establish the Nonpoint Source (NPS) Management Program in Section 319 of that act. Through that program, States, Territories, and Native American Tribes can receive grant monies for a variety of activities, including the restoration of impaired stream segments. Although there are several sources of money to help with the TMDL implementation process, Section 319 funds are most relevant to TMDL implementation. Therefore, the requirements to obtain these funds are discussed in this chapter. The Virginia Department of Conservation and Recreation (VADCR) strongly suggests that these USEPA recommendations be addressed in the IP (in addition to the required components as described by WQMIRA).

The USEPA develops guidelines that describe the process and criteria to be used to award CWA Section 319 NPS grants to States. The guidance is subject to revision and the most recent version should be considered for IP development. The "Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003" identifies the following nine elements that must be included in the IP to meet the 319 requirements:

1. Identify the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in the watershed-based plan;
2. Estimate the load reductions expected from NPS management measures;
3. Describe the NPS management measures that will need to be implemented to achieve the identified load reductions;
4. Estimate the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement the watershed-based plan;
5. Provide an information/education component that will be used to enhance public understanding of the project and encourage the public's participation in selecting, designing, and implementing NPS management measures;
6. Provide a schedule for implementing the NPS management measures identified in the watershed-based plan;
7. Describe interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented;

8. Identify a set of criteria for determining if load reductions are being achieved and progress is being made towards attaining water quality standards, and if not, the criteria for determining if the watershed-based plan needs to be revised; and
9. Establish a monitoring component to evaluate the effectiveness of the implementation efforts.

2.5. Staged Implementation

In general, the Commonwealth of Virginia intends for NPS pollutant TMDL reductions to be implemented in a staged or phased fashion. Staged implementation is an iterative process whereby management measures are implemented incrementally, initially targeting those sources and/or practices that are expected to produce the greatest water quality improvement. Staged implementation includes on-going monitoring to continuously assess progress toward attaining water quality standards. For example, a promising best management practice in agricultural areas of a watershed with a bacteria impairment is livestock exclusion from streams. This has been shown to be very effective in lowering bacteria concentrations in streams, by reducing the opportunity for cattle to defecate directly in the stream and by providing additional buffering in the riparian zone. This practice has the additional benefit of reducing stream bank erosion.

There are many benefits of staged implementation, including:

1. tracking water quality improvements as they occur;
2. providing a measure of quality control, given the uncertainties that exist in any implementation plan;
3. providing a mechanism for developing public support;
4. helping to ensure the most cost-effective practices are implemented initially; and
5. allowing for the evaluation of the adequacy of the TMDL in achieving the water quality standard.

With successful development and implementation of IPs, Virginia will be well on the way to restoring impaired waters and enhancing the value of this important resource. Additionally, development of an approved IP will improve a locality's chances for obtaining monetary assistance during implementation.

3. REVIEW OF THE REED CREEK BACTERIAL TMDL STUDY

3.1. Background

A TMDL is calculated as follows:

$$TMDL = \sum WLA + \sum LA + MOS \quad (3.1)$$

where WLA is the waste load allocation (point sources), LA is the load allocation (NPSs), and MOS is the margin of safety. A TMDL study determines the TMDL for the pollutant and, after accounting for MOS, allocates that loading between point sources (WLA) and NPSs (LA).

This chapter reviews how the TMDLs were developed for the twelve impaired segments of Reed Creek watershed and the load allocations required to meet the TMDLs. The TMDLs are described in the 2012 TMDL report: *Bacteria Total Maximum Daily Load Development for Mill Creek, Cove Creek, Miller Creek, Stony Fork, Tate Run, South Fork Reed Creek, and Reed Creek in Wythe County, Virginia.*

3.2. Description of Impairments in the Reed Creek Watershed

A segment of Reed Creek (VAS-N10R_RDC01A00) was first listed as impaired in 2002 due to water quality violations of the fecal coliform standard. Another segment of Reed Creek (VAS-N11R_RDC03B04) was listed as impaired in 2004 due to water quality violations of the *E. coli* standard. Additional segments of Reed Creek (VAS-11NR_RDC01B00, VAS-N11R_RDC02B02, VAS-N10R_RDC01A02, and VAS-N10R_RDC01B00) were listed in 2006. South Fork Reed Creek (VAS-N10R_RSF01A00), Mill Creek (VAS-10R_MCE01A02), Stony Fork (VAS-N10R_SFK01A02), Tate Run (VAS-N10R_TAT01A06), Cove Creek (VAS-N12R_CVR01A00), and Miller Creek (VAS-N11R_MER01A06) all tributaries in the Reed Creek watershed were also listed as impaired in 2006 due to water quality violations of the *E. coli* standard. The impairments are summarized in Table 3-1 and Figure 3-1. The impaired segments of Miller Creek and Tate Run are shown more clearly in Figure 3-2 and Figure 3-3, respectively.

Table 3-1. Impaired segments in the Reed Creek watershed.

Impaired Segment	Size	Initial Listing Year	Description
Miller Creek (VAS-N11R_MER01A06)	0.42 miles	2006	extending from the Beaverdam confluence at Max Meadows to the Reed Creek confluence
Cove Creek (VAS-N12R_CVR01A00)	9.10 miles	2006	extending from the confluence with St. Lukes Fork to the confluence with Reed Creek
Mill Creek (VAS-N10R_MCE01A02)	6.18 miles	2006	extending from the mainstem to the confluence with Reed Creek
South Fork Reed Creek (VAS-N10R_RSF01A00)	6.72 miles	2006	extending from mainstem from river mile 6.8 to the confluence with Reed Creek
Stony Fork (VAS-N10R_SFK01A02)	6.66 miles	2006	extending from the headwaters to the Reed Creek confluence
Tate Run (VAS-N10R_TAT01A06)	0.52 miles	2006	extending from the Stuffle Run confluence to the Reed Creek confluence
Reed Creek (VAS-N10R_RDC01A00)	1.46 miles	2002	extending from the Pine Run confluence to the Venrick Run confluence
Reed Creek (VAS-N10R_RDC01A02)	5.18 miles	2006	extending from the Stony Fork confluence to the South Fork Reed Creek confluence
Reed Creek (VAS-N10R_RDC01B00)	9.75 miles	2006	extending from the Stony Fork confluence upstream to the Guillion Fork confluence
Reed Creek (VAS-N11R_RDC01B00)	5.71 miles	2006	extending from the Muskrat Branch confluence to the Miller Creek confluence
Reed Creek (VAS-N11R_RDC02B02)	6.01 miles	2006	extending from Beaverdam Creek to Glade Creek
Reed Creek (VAS-N11R_RDC03B04)	9.75 miles	2004	extending from the Glade Creek confluence to the confluence with the New River

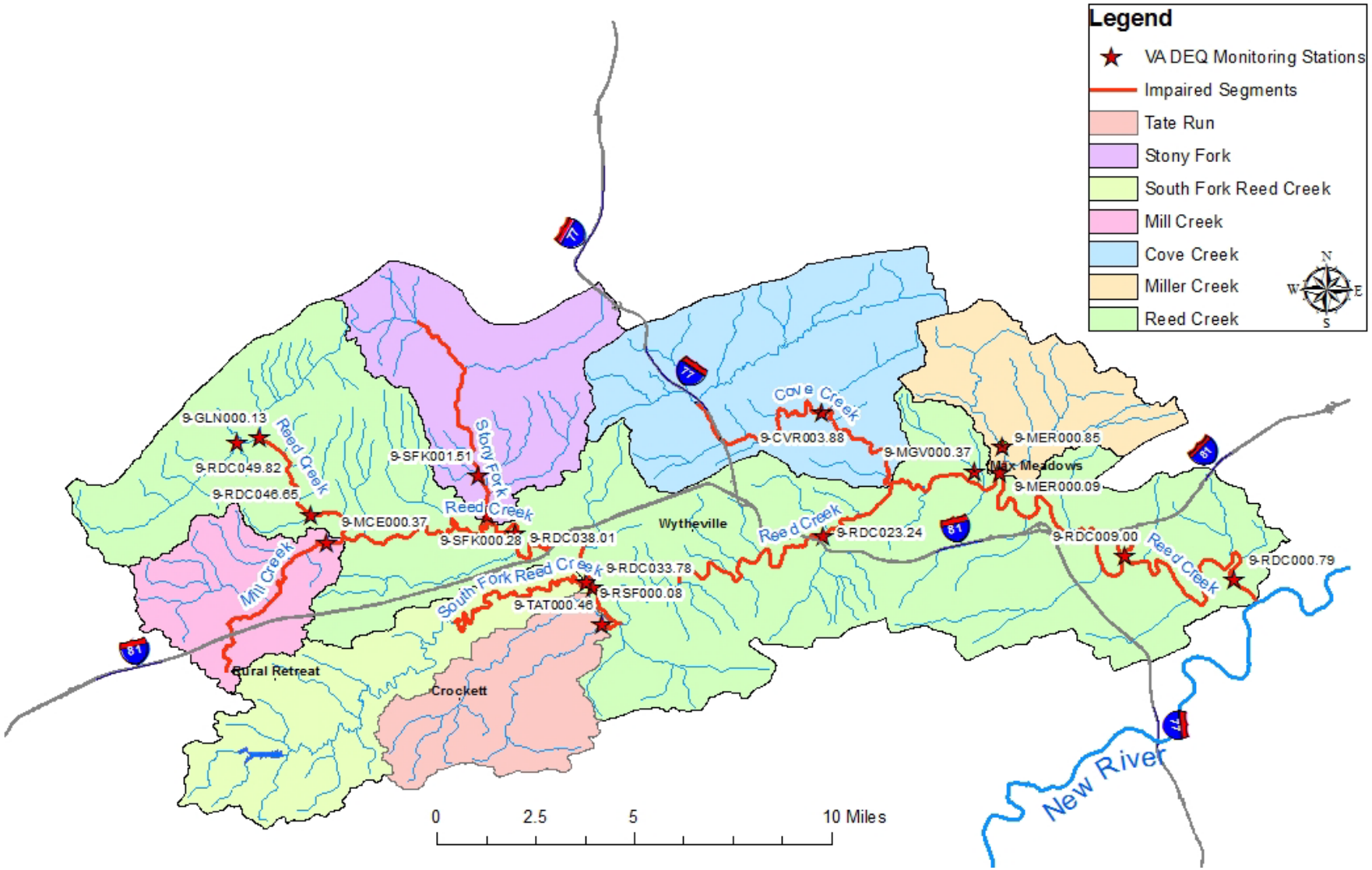

Figure 3-1. Impaired segments in the Reed Creek watershed.

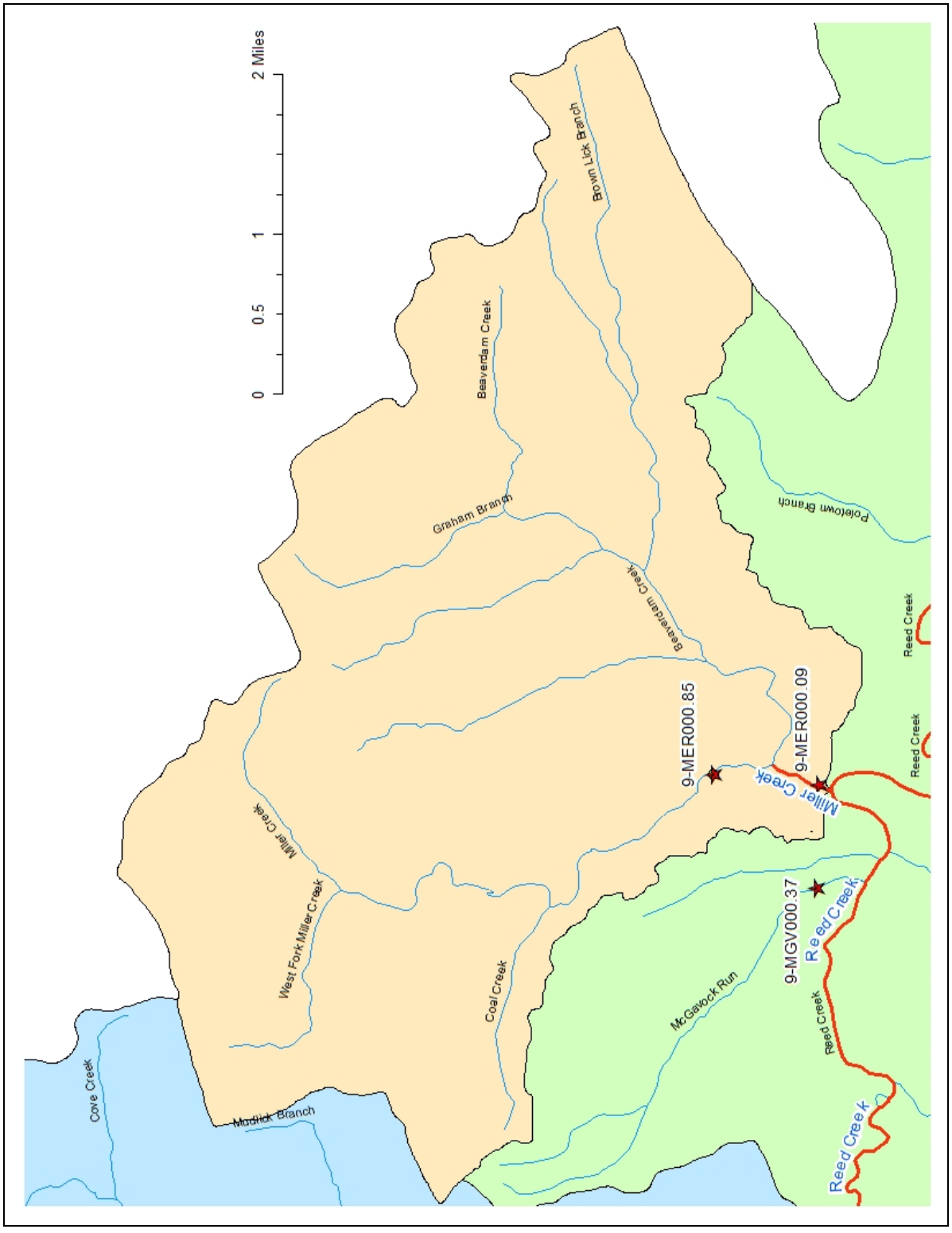

Figure 3-2. Miller Creek watershed.

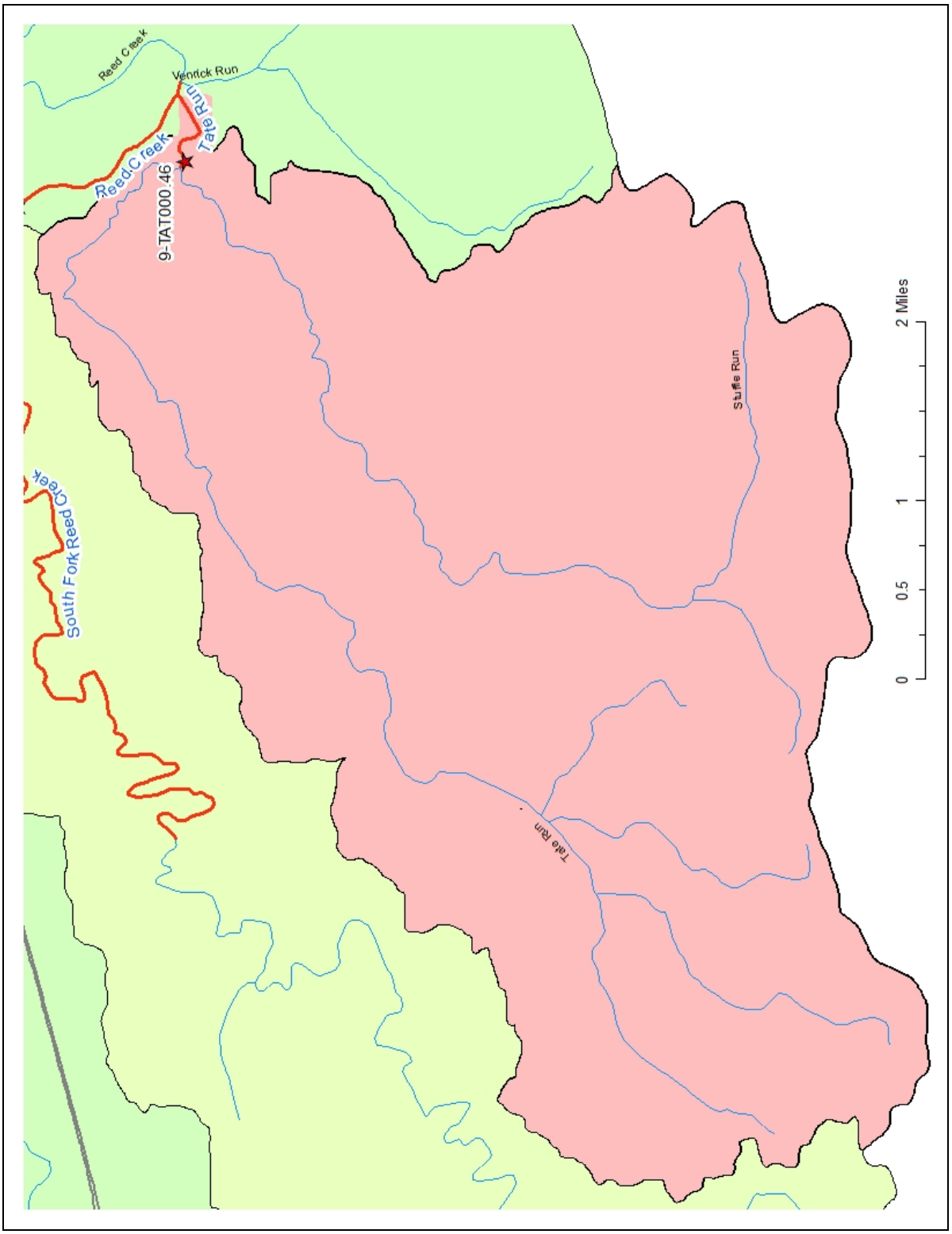

Figure 3-3. Tate Run watershed.

3.3. Watershed Characteristics

The Reed Creek watershed is located in Wythe County. The watershed is approximately 173,828 acres and is part of the New River Basin. The predominant land use in the Reed Creek watershed is forest (52%), with additional significant areas in pasture and hay land (38%); less significant land uses are residential (8%) and cropland (2%) (Figure 3-4). Reed Creek flows into the New River which flows north into the Kanawha River. The Kanawha is a tributary of the Ohio River, which flows into the Mississippi River, with the Mississippi discharging into the Gulf of Mexico.

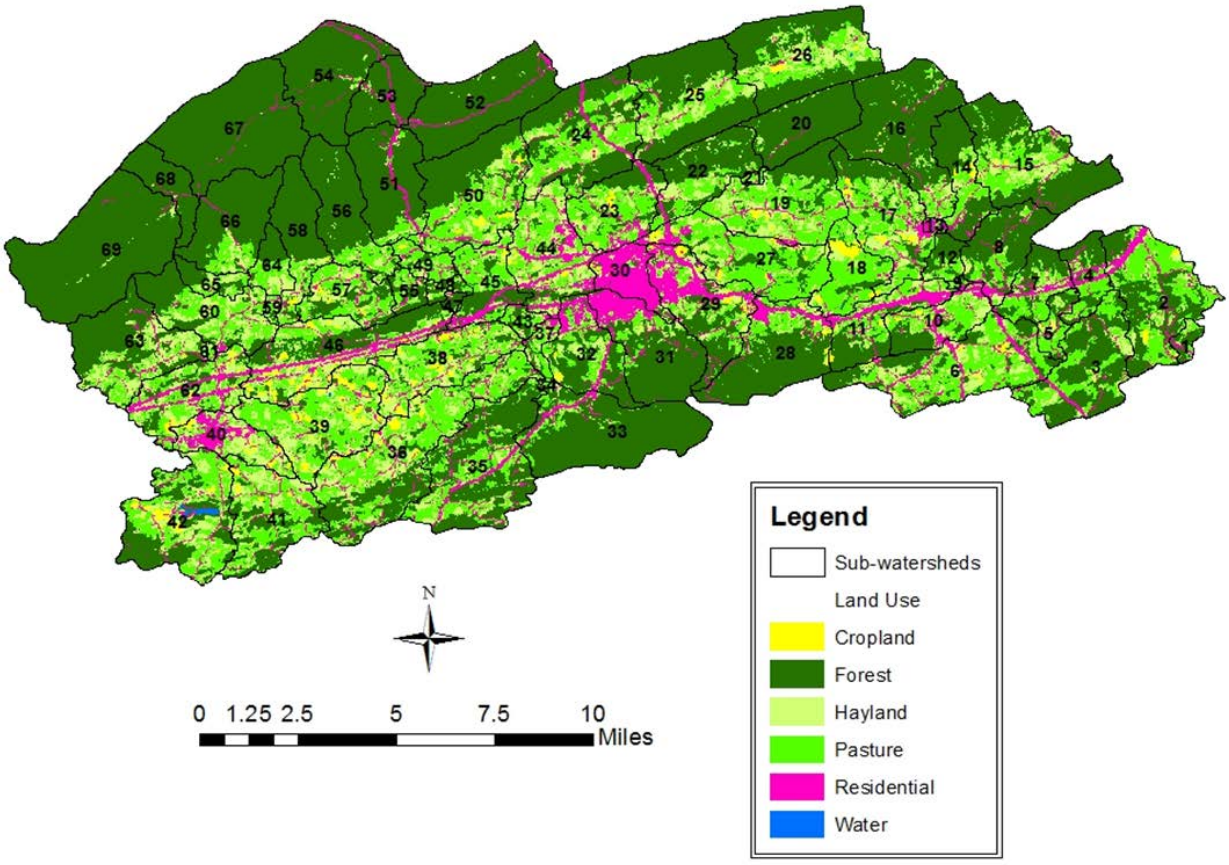

Figure 3-4. Land use distribution in the Reed Creek watershed.

3.4. Water Quality Monitoring

There are seventeen water quality monitoring stations located in the Reed Creek watershed. Table 3-2 lists the stations, the violation rate of the appropriate instantaneous water quality criterion (fecal coliform - 200 cfu/100 mL; *E. coli* - 235 cfu/100 mL), and the period of record. Of these stations only two, stations 9-MER000.85 and 9-MGV000.37, did not have enough data to be included in the water quality calibration and validation.

3.5. Water Quality Modeling

The Hydrological Simulation Program-FORTRAN (HSPF) was used to simulate the fate and transport of fecal coliform bacteria in the Reed Creek watershed. Modeling was conducted in phases. Output from the HSPF model was generated as an hourly time series and daily average time series of fecal coliform concentration at 69 sub-watershed outlets.

Table 3-2. Description of Monitoring Stations used in TMDL Development

Station ID	Stream Name	Station Description	Indicator Organism Measured	Number of Samples	Violation Rate of the Instantaneous Standard	Period of Record
9-CVR003.88	Cove Creek	Bridge on Rt. 647 off Rt. 610	*E. coli*	23	52%	2003 - 2010
9-MER000.09	Miller Creek	Bridge on Rt. 614 off Rt. 121	*E. coli*	23	61%	2003 - 2010
9-MER000.85	Miller Creek	Rt. 610 bridge #6010 at Max Meadows	*E. coli*	10	20%	2009 - 2010
9-MGV000.37	McGavak Run	Route 618 culvert at private drive	*E. coli*	11	18%	2009 - 2010
9-RDC000.79	Reed Creek	Swinging Bridge on Rt. 618 off 81 exit 86	*E. coli*	23	8%	2003 - 2010
9-RDC009.00	Reed Creek	Rt. 619 at Gaging Station	Fecal Coliform	257	24%	1970 - 2011
			E. coli	46	6%	2002 - 2011
9-RDC023.24	Reed Creek	Bridge on Rt. 649 at transfer station	*E. coli*	23	30%	2003 - 2010
9-GLN000.13	Gullion Fork	Bridge on Rt. 625	*E. coli*	24	12%	2003 - 2010
9-MCE000.37	Mill Creek	Bridge on Rt. 830 off Rt. 680	*E. coli*	24	58%	2003 - 2010
9-RDC033.78	Reed Creek	Pull off on Rt. 655 off Rt. 684	*E. coli*	15	60%	2003 - 2009
9-RDC038.01	Reed Creek	Rt. 663 off Rt. 11	*E. coli*	24	33%	2003 - 2010
9-RDC046.65	Reed Creek	Bridge on Rt. 625 off Rt. 680	*E. coli*	24	29%	2003 - 2010
9-RDC049.82	Reed Creek	FS road off Rt. 625	*E. coli*	24	17%	2003 - 2010
9-RSF000.08	Reed Creek, South Fork	Off Rt. 667 on Avery Lane	*E. coli*	24	67%	2003 - 2010
9-SFK000.28	Stony Fork	Bridge on Rt. 664 off Rt. 666	*E. coli*	23	52%	2003 - 2010
9-SFK001.51	Stony Fork	Off US 21/52	*E. coli*	24	38%	2003 - 2010
9-TAT000.46	Tate Run	Bridge on Rt. 655 off Rt. 684	*E. coli*	24	54%	2003 - 2010

The Expert System for Calibration of HSPF (HSPEXP) decision support software was used to develop a calibrated hydrologic HSPF input dataset for the Reed Creek watershed. Data for

calibration were obtained from a USGS flow-monitoring station (USGS 03167000), located on Reed Creek near Grahams Forge, VA. The water quality component of HSPF was calibrated using observed fecal coliform and *E. coli* data collected at the stations listed in Table 3-2.

While developing allocation scenarios, an implicit margin of safety (MOS) was used. Conservative assumptions, the use of a detailed watershed model (HSPF), and other considerations were used in developing the bacteria TMDL, such that an explicit MOS was not necessary.

3.6. Sources of Bacteria

To identify localized sources of fecal coliform, watersheds were divided into sub-watersheds (Figure 3-5) as follows: Mill Creek, sub-watersheds 59-63; Cove Creek, sub-watersheds 19-26; Miller Creek, sub-watersheds 13-16; Stony Fork, sub-watersheds 49-54; Tate Run, sub-watersheds 34-36; South Fork Reed Creek, sub-watersheds 38-42; and mainstem Reed Creek, sub-watersheds 1-12, 17, 18, 27-33, 37, 43-48, 55-58, 64-69. Potential sources of bacteria considered in the development of the TMDL included both point source and non-point source (NPS) contributions.

3.6.1. Point Sources

The TMDL WLA accounts for the portion of a receiving water's loading capacity that is allocated to one of its existing or future permitted point sources of pollution. Point sources of fecal coliform bacteria in Reed Creek watershed include all municipal and industrial plants that treat human waste and are issued individual permits by VADEQ, as well as private residences that fall under Virginia Pollutant Discharge Elimination System (VPDES) general permits. The point sources of bacteria in Reed Creek watershed are listed in Table 3-3, along with their permitted discharges and load allocations in the TMDLs. The WLA for each point source was set at the permitted load.

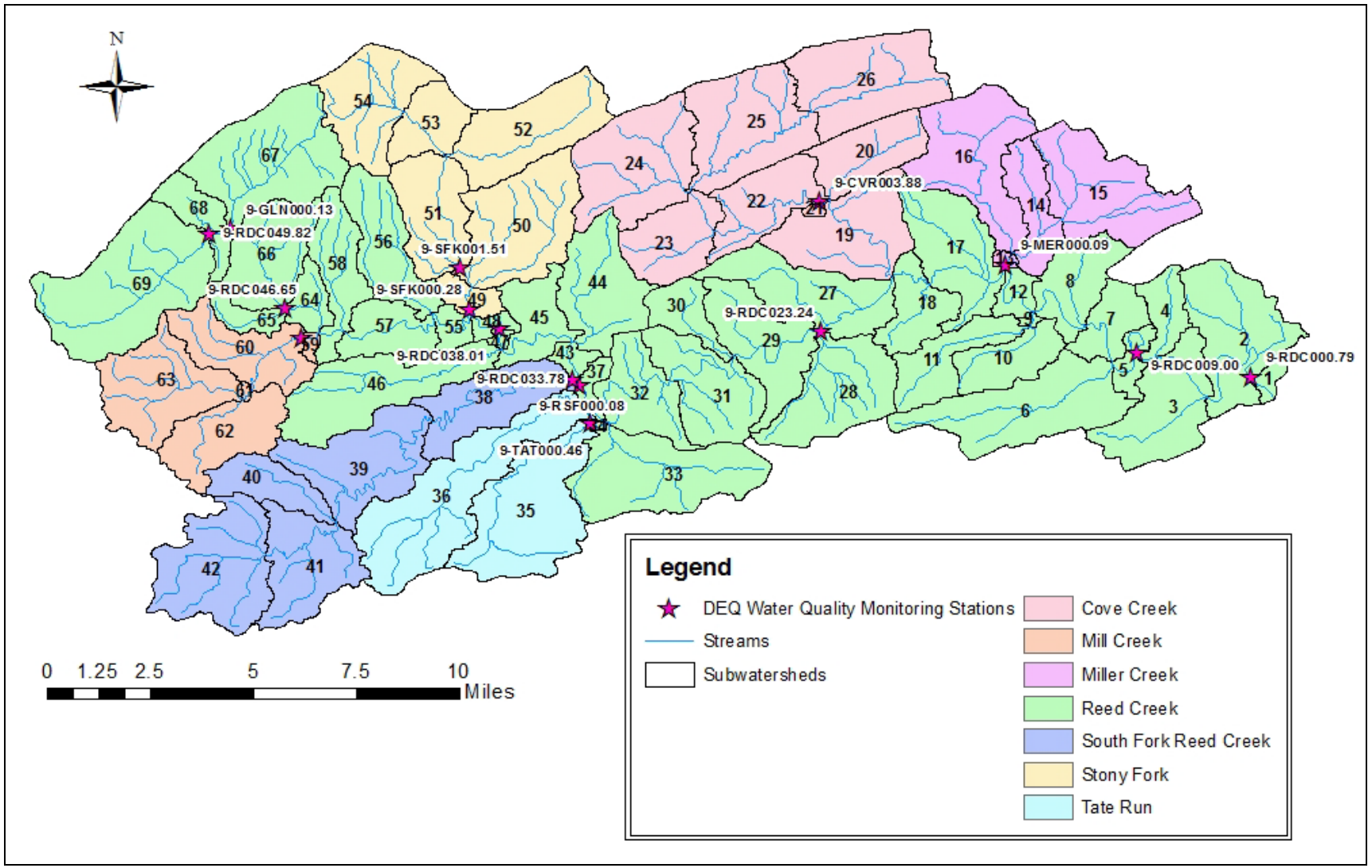

Figure 3-5. Sub-watersheds in the Reed Creek watershed.

Table 3-3. Permitted facilities discharging into streams of the Reed Creek watershed.

Permit Number	Facility Name	Sub-watershed	Design Flow (mgd*)	Permitted *E. coli* Conc. (cfu/100 mL)	*E. coli* Load (cfu/year)
VA0021326	Rural Retreat STP	40	0.25	126	4.35×10^{11}
VA0059137	DGIF - Wytheville Fish Cultural Station	6	0.54	126	9.41×10^{11}
VA0068144	DGIF - Wytheville Fish Cultural Station	6	0.002	126	3.48×10^{9}
VA0090549	Flying J 754 - Wytheville	11	0.001	126	1.74×10^{9}
VA0092398	Flying J 750 - Max Meadows	11	0.0003	126	5.23×10^{8}
VA0074161	Fort Chiswell WWTP	9	2	126	3.48×10^{12}
VA0090956	Loves Travel Stops and Country Stores 239	7	0.001	126	1.74×10^{9}
VA0020281	Wytheville WWTP	29	4	126	6.97×10^{12}
VA0024490	Edgemont Center Incorporated STP	29	0.0271	126	4.72E+10
VA0065706	I-81 Travel Plaza - Max Meadows	2	0.015	126	2.61×10^{10}
VA0091847	SVC Manufacturing Inc. - QTG Blue Ridge Facility	19	0.085	126	1.48×10^{11}
VAG400652	Single Family Home	27	0.001	126	1.74×10^{9}
VAG400843	Single Family Home	5	0.001	126	1.74×10^{9}
VAG400883	Single Family Home	35	0.001	126	1.74×10^{9}

*million gallons per day

3.6.2. Nonpoint Sources

NPS pollution originates from diffuse sources on the landscape (e.g., agriculture and urban) and is strongly affected by precipitation events – runoff from rain or snowmelt. In some cases, a precipitation event is not required to deliver NPS pollution to a stream (e.g., direct deposition of fecal matter by wildlife or livestock and contamination from leaking sewer lines or straight pipes). NPSs were assessed during TMDL development through an extensive analysis of land use coupled with a consideration for delivery mechanisms (e.g., direct loadings to the stream or land-based loadings that require a precipitation event for delivery of the pollutants to the stream from pervious and impervious surfaces).

In general, wildlife contribute bacteria to all land uses and to streams via defecating directly in streams (direct deposit); livestock contribute bacteria to pasture areas and streams via direct deposit and indirectly to crop areas through manure application; humans contribute bacteria to

residential areas via failing septic systems and to streams via straight pipes; and pets contribute bacteria directly to residential areas. Relative contributions of bacteria from each of the sources are summarized in Table 3-4.

Table 3-4. Estimated relative contributions of different *E. coli* sources to the overall *E. coli* concentration for the Reed Creek watershed.

Source	Mean Daily *E. coli* Concentration by Source (cfu/100mL)	Relative Contribution by Source
Direct loading to streams		
Livestock in stream	102	52%
Wildlife in stream	22	11%
Straight pipes	5	3%
Point Sources	7	4%
Interflow and Groundwater	3	1%
Storm Runoff		
Livestock	47	24%
Wildlife	4	2%
Septic	3	1 %
Pets	3	1%
Total	**196**	

3.7. TMDL Allocations and Load Reductions

Various pollutant reduction scenarios were evaluated to meet the state water quality standard for *E. coli*, the 30-day geometric mean target (126 cfu/100 mL), with zero violations (a requirement of the TMDL). An implicit MOS was used in these bacteria TMDLs by using conservative estimations of factors that would affect bacteria loadings in the watershed (e.g., animal numbers, production rates, contributions to the stream). These factors were estimated in such a way as to represent the greatest amount of bacteria from each source in the watershed.

The Reed Creek TMDLs call for reductions from agricultural and residential sources; and for three impaired stream segments, wildlife reductions are also needed to meet the TMDLs. The final allocation scenarios from each watershed are shown in Table 3-5. The TMDL equations, which include *E. coli* allocations for point (WLA) and non-point (LA) sources, are given in Table 3-6.

Table 3-5. Final pollutant source reduction scenarios for the Reed Creek watershed.

Impaired Segment	Cattle Direct Deposit	Loads from Cropland	Loads from Pasture	Straight Pipes	Loads from Residential		Wildlife Direct Deposit
					Failing Septic Systems	Pets and Wildlife	
Mill Creek	100	0	85	100	100	0	20
Cove Creek	100	0	0	100	100	0	0
Miller Creek	100	0	0	100	100	0	0
Stony Fork	100	0	90	100	100	0	15
Tate Run	100	0	95	100	100	0	10
S Frk Reed Crk	100	0	55	100	100	0	0
Reed Creek N10R_RDC01B00	90	0	0	100	100	0	0
Reed Creek N10R_RDC01A02	65	0	0	100	100	0	0
Reed Creek N10R_RDC01A00	15	0	0	100	100	0	0
Reed Creek N11R_RDC01B00	15	0	0	100	100	0	0
Reed Creek N11R_RDC02B02	15	0	0	100	100	0	0
Reed Creek N11R_RDC03B04	15	0	0	100	100	0	0

Table 3-6. TMDL equations for the Reed Creek watershed (annual *E. coli* loadings in cfu/yr).

Impaired Segment	ΣWLA	ΣLA	MOS*	TMDL
Mill Creek	6.79×10^{10}	672.27×10^{10}	--	679.06×10^{10}
Cove Creek	7.40×10^{11}	733.46×10^{11}	--	740.86×10^{11}
Miller Creek	2.63×10^{11}	261.72×10^{11}	--	263.35×10^{11}
Stony Fork	9.00×10^{10}	890.63×10^{10}	--	899.63×10^{10}
Tate Run	7.99×10^{10}	773.76×10^{10}	--	781.75×10^{10}
S Frk Reed Crk	2.18×10^{12}	38.78×10^{12}	--	40.96×10^{12}
Reed Creek N10R_RDC01B00	4.32×10^{11}	427.61×10^{11}	--	431.93×10^{11}
Reed Creek N10R_RDC01A02	8.71×10^{11}	862.61×10^{11}	--	871.32×10^{11}
Reed Creek N10R_RDC01A00	2.18×10^{12}	134.01×10^{12}	--	136.19×10^{12}
Reed Creek N11R_RDC01B00	3.80×10^{13}	32.06×10^{13}	--	35.86×10^{13}
Reed Creek N11R_RDC02B02	5.54×10^{13}	36.54×10^{13}	--	42.08×10^{13}
Reed Creek N11R_RDC03B04	6.03×10^{13}	39.32×10^{13}	--	45.35×10^{13}

†the WLA will be implemented in accordance with permitting regulations
*Implicit MOS

In addition to the final pollutant source reduction scenarios, a transitional (Stage 1) pollutant source reduction scenario was developed during the TMDL study, Table 3-7. The Stage 1 scenario allows a 10.5% violation rate of the applicable single-sample *E. coli* criterion, 235 cfu/100 mL, and reflects smaller pollutant source reductions from agricultural sources. Implementation of the Stage 1 scenario permits an evaluation of the modeling assumptions and the effectiveness of management practices.

Table 3-7. Allocation scenarios for Stage 1 implementation for the impaired segments.

Impaired Segment	Cattle Direct Deposit	Loads from Cropland	Loads from Pasture	Straight Pipes	Loads from Residential		Wildlife Direct Deposit
					Failing Septic Systems	Pets and Wildlife	
Mill Creek	95	0	0	100	100	0	0
Cove Creek	85	0	0	100	100	0	0
Miller Creek	95	0	0	100	100	0	0
Stony Fork	95	0	0	100	100	0	0
Tate Run	100	0	0	100	100	0	0
S Frk Reed Crk	90	0	0	100	100	0	0
Reed Creek N10R_RDC01B00	0	0	0	100	100	0	0
Reed Creek N10R_RDC01A02	0	0	0	100	100	0	0
Reed Creek N10R_RDC01A00	0	0	0	100	100	0	0
Reed Creek N11R_RDC01B00	0	0	0	100	100	0	0
Reed Creek N11R_RDC02B02	0	0	0	100	100	0	0
Reed Creek N11R_RDC03B04	0	0	0	100	100	0	0

4. PUBLIC PARTICIPATION

4.1. Introduction

An essential step in crafting a TMDL implementation plan and then implementing that plan is input from and engagement of a broad range of stakeholders (individuals, agencies, organizations, and businesses who have an interest in improving water quality and a familiarity with local conditions). Public participation involves a dialogue between local stakeholders and government agencies and a discussion of available resources that can be devoted to TMDL implementation, such as funding and technical support.

The stakeholders involved in developing the Reed Creek TMDL IP included two Work Groups, and the general public. The two Work Groups (one focused on agricultural and residential issues and another on funding and technical resource issues) were comprised of representatives from VADEQ, VADCR, Big Walker Soil and Water Conservation District (SWCD), Wythe County Water and Waste Water Department, and local watershed stakeholders. Public participation occurred via a series of Work Group meetings, Table 4-1. These meetings, as well as additional public participation activities, are described in the following section.

Table 4-1. Reed Creek TMDL Implementation Planning Meetings

Meeting Date	Meeting Type
April 19, 2012	Final TMDL Public Meeting and IP Informational Kick-off Meeting
June 11, 2012	Government Work Group
August 9, 2012	Agricultural and Residential Work Group
September 4, 2012	Final Public Meeting

4.2. Synopsis of Reed Creek TMDL Implementation Planning Meetings

The first of two public-noticed public meetings for implementation planning occurred on April 19, 2012 at the Wythe Bland Conference Room at the Wythe County Community Hospital in Wytheville Virginia. This public meeting served as both the final TMDL meeting and the kick-off meeting for implementation planning and had nine attendees. The goals of the public meeting were:

- to present the bacteria TMDLs for Mill Creek, Cove Creek, Miller Creek, Stony Fork, Tate Run, South Fork Reed Creek, and the mainstem Reed Creek;
- to provide a basic introduction to the process of implementing TMDLs;
- to engage the community through the Work Groups; and

- to explain the roles and responsibilities of each Work Group and the commitment needed for a successful process.

Work Groups were developed that included stakeholders with common interests and concerns about the implementation process. The Agricultural and Residential Work Group focused on agricultural and residential issues, while the Government Work Group focused on funding and technical resources. Each Work Group was charged with discussing, analyzing, and prioritizing potential bacteria pollutant source reduction corrective measures.

Work Group meetings occurred on June 11, 2012 and August 9, 2012. The Work Groups provided an opportunity for participants to give direct feedback about potential sources of problems and appropriate solutions to impairments. The goals of these meetings were:

- to review the IP purpose and development process;
- to identify locations of known or suspected water quality problems due to bacteria; and
- to identify corrective measures (BMPs and other approaches) for reducing bacteria loads.

The second and final public meeting for Implementation Plan development occurred on September 4, 2012 at the Wythe Bland Conference Room at the Wythe County Community Hospital in Wytheville, Virginia, nine people attended the meeting. The goals of the meeting were:

- to review the TMDL implementation planning process and the implementation chronology laid out in the TMDL IP;
- to introduce opportunities of assistance available to landowners for practices to reduce bacteria; and
- to solicit stakeholder feedback (a formal 30-day public comment period following the final public meeting).

5. IMPLEMENTATION ACTIONS

An important element of the TMDL implementation plan is to encourage voluntary implementation of control measures designed to reduce pollutant loads. To encourage voluntary implementation, information must be obtained on the types of control measures that can achieve the pollutant reduction goals specified in the TMDL as practically and cost-effectively as possible. In other words, control measures that provide "the biggest bang for the buck" are targeted.

5.1. Selection of Appropriate Control Measures

Potential control measures, their costs, and pollutant removal effectiveness estimates were identified through a review of the Reed Creek TMDL report, through input from the TMDL IP Work Group, from a literature review, and from modeling. Because the Reed Creek watersheds contain a combination of agricultural and residential land uses, implementation actions to address the required pollutant reductions include a variety of control measures which target each pollutant source. Control measure selection was based on the ability to control specific pollutant sources, the required pollutant load reductions, the potential for cost-sharing, the likelihood of implementation by landowners, and stakeholder input. Pollutant sources fall into two basic categories: those contributing directly to the stream and those contributing indirectly to the stream from land sources via runoff. A list of potential control measures and their effectiveness values are listed in Table 5-1.

5.1.1. Control Measures for Direct Stream Sources

Control measures were needed to reduce pollutant sources that contribute directly to the stream, "Direct Stream Sources". The Direct Stream Sources that need to be controlled in Reed Creek include livestock direct deposit and direct residential wastewater discharges (straight pipes). To meet the reductions in direct deposits from livestock specified in the TMDL, some form of stream exclusion is necessary. The 100% reduction in bacteria loads from the direct residential wastewater discharges is a pre-existing legal requirement, further reinforced by the TMDL and this TMDL IP. Control measures used to address residential wastewater discharges include new septic systems or alternative on-site sewage treatment systems.

Table 5-1. Potential Control Measure Efficiencies for Bacteria.

Control Measures	Associated Cost-shared BMPs	Bacterial Reduction Effectiveness (%)	Effectiveness Source
Agricultural Control Measures			
Grass riparian buffers~	CP-21, WQ-1	40%	1
Forested riparian buffers~	CP-22, CRFR-3, FR-3	40%	1
Reforestation of erodible pasture	FR-1	simulated	2
Livestock exclusion fencing	CRSL-6, LE-1T, LE-2T, SL-6T, WP-2T	100%	4
Livestock exclusion buffers or setbacks	CRSL-6, LE-1T, LE-2T, SL-6T, WP-2T	40%	1
Hardened crossings*			
Alternative water systems*			
Loafing lot management system	WP-4B	40%	1
Improved pasture management	EQIP 528, EQIP 512	30%	1
Water control structure	WP-1	60%	1
Barnyard runoff controls		40%	1
Continuous no-till system	SL-15A	70%	1
Cover crop	SL-8B	20%	1
Residential Control Measures			
Septic System pump-out	RB-1	5%	3
New Sewer hook-ups	RB-2	100%	4
Septic System repairs	RB-3	100%	4
New septic systems	RB-4	100%	4
New septic systems w/ pumps	RB-4P	100%	4
Alternative on-site waste treatment systems	RB-5	100%	4

~ Includes additional reductions from upstream runoff loads: buffers - 2x buffer area.
* Included as part of exclusion fencing systems (CRSL-6,LE-1T, LE-2T, SL-6T).
1 - EPA-CBP sediment effectiveness, 2010. (Bacteria efficiency assumed equal to sediment efficiency.)
2 - Based on unit bacteria load from wildlife.
3 - EPA-CBP nutrient effectiveness, 2010. (Bacteria efficiency assumed equal to nutrient efficiency.)
4 - By definition.

5.1.2. Control Measures for Indirect Land Sources

Control measures were also needed to reduce pollutant sources that are distributed across the land surface, whose loads are then transported to streams via surface runoff, “Indirect Land Sources”. Control measures may reduce bacteria loads to the land surface, or may reduce bacteria transport via surface runoff by increasing infiltration, improving filtration, or causing deposition (reductions in flow velocity). The Indirect Land Sources that need to be controlled

include runoff from pasture (livestock) and residential areas (failing septic systems and sewage spills).

Appendix A provides a glossary of BMP and other control measure definitions. Appendix B contains a list of BMP codes and practice names.

5.2. Quantification of Control Measures by Pollutant Source

The extent of existing control measures previously implemented in the Reed Creek watersheds were quantified using the VADCR and USDA Conservation Reserve Enhancement Program (CREP) databases and from estimates provided by local citizens, NRCS, and the Big Walker SWCD. The initial list of control measures considered for the Reed Creek TMDL IP included those practices already installed in the watersheds, given that there is already some degree of acceptability for these types of control measures. An analysis was then performed to identify the maximum extent of each measure needed to meet the pollutant reduction goals. The initial list of control measures was supplemented with additional measures through discussions with stakeholders. The suite of control measures available to meet the TMDL bacteria reduction targets were identified through discussions with Work Group participants and quantified using a combination of GIS analysis and modeling, followed by spreadsheet analyses to calculate load reductions from each control measure as applied to each pollutant type and source category. This section provides a summary of the final set of control measures and extents needed to achieve the pollutant load reductions specified in the bacteria TMDLs. Load reductions were based on bacteria source loads simulated for the TMDL study and control measure effectiveness estimates.

5.2.1. Livestock Direct Deposit

Eliminating unrestricted livestock access to streams (livestock exclusion) is assumed to provide 100% reduction in livestock direct deposits. A GIS analysis was performed to delineate stream lengths adjacent to, or included in, pasture areas in the Reed Creek watersheds. NLCD land use data layers were used for this analysis. The National Hydrography Dataset (NHD) streams layer was used to represent streams and to classify them as either perennial or intermittent.

“Incentive-based livestock exclusion fencing” is defined as fencing that meets VADCR or federal CREP (Conservation Reserve Enhancement Program) cost-share requirements with a minimum of a 10 ft. setback or 35 ft. buffer, while “alternative fencing” is defined as any fencing with a setback decided upon by the landowner that does not meet cost-share requirements. The option of “alternative fencing” was discussed during the agricultural and residential work group

meeting. The work group decided that alternative fencing practices would not be popular with agricultural producers in the Reed Creek watersheds, as they would prefer to take advantage of the offered cost-share incentives. Table 5-2 summarizes the total fencing needs estimated to achieve the reductions in bacteria loads from livestock direct deposits in the Reed Creek watersheds, as specified in the TMDLs.

Table 5-2. Total Stream Fencing Estimates.

Sub-Basin	Total Possible Pasture Fencing for Perennial Streams* (miles)	Existing BMP Streamside Fencing† (miles)	Fencing Needed			
			Stage 1		Stage 2	
			%	miles	%	miles
Mill Creek	19.7	0.5	95	18	100	1
Cove Creek	35.7	3.7	85	27	100	5
Miller Creek	11.9	3.3	95	8	100	1
Stony Fork	12.7	0.5	95	12	100	1
Tate Run	21.1	-	100	21	100	-
South Fork Reed Creek	41.6	9.3	90	29	100	3
Reed Creek (headwaters to Stony Fork)	17.0	1.2	0	-	90	14
Reed Creek (Stony Fork to South Fork Reed Creek)	11.2	-	0	-	65	7
Reed Creek (South Fork Reed Creek to New River)	53.8	7.4	0	-	15	7
Total	**224.6**	**25.9**		**115**		**39**

* May have pasture on one or both sides.
† Estimated length of exclusion fencing – sources: VADCR BMP database, Agricultural and Residential Work Group.

Agricultural producers have an array of voluntary water protection measures to choose from that include financial incentives. Some applicable cost-shared BMPs for livestock exclusion in the Reed Creek watershed are the LE-1T (Livestock Exclusion with Riparian Buffers for TMDL Implementation), the LE-2T (Livestock Exclusion with Reduced Setback for TMDL Implementation), the SL-6T (Stream Exclusion with Grazing Land Management for TMDL Implementation), and the WP-2T (Stream Protection for TMDL Implementation) offered through the Virginia BMP Cost-Share Program, and CREP's CRSL-6 (CREP Stream Exclusion). The LE-1T practice includes streamside fencing, cross fencing, alternative water system(s), hardened crossing(s) when needed, and a 35-ft buffer from the stream. The LE-2T practice is similar to the LE-1T practice, except the stream exclusion fencing must be placed a minimum of 10 feet from the stream and the cost-share rate is less than for LE-1T. The SL-6T practice

requires a minimum 35-ft buffer from the stream, and includes cost-share for livestock watering systems, fencing and a hardened pad for winter-feeding. The WP-2T practice is similar to the LE-1T practice, except it does not include an alternative watering system and the cost-share rate is less. The WP-2T system may be a suitable option where a watering system already exists. The CRSL-6 practice is similar to the LE-1T practice, but with a different cost-share percentage.

Based on Agricultural and Residential Work Group discussions, it is expected that targeted implementation of the LE-1T systems will address the majority of the livestock exclusion fencing needs in the watershed (75%, length basis). The remaining fencing needs will be met through implementation of LE-2T practices (15%), SL-6T practices (4%), CRSL-6 practices (4%), and WP-2T practices (2%). This IP quantifies fencing along perennial streams because highest priority should be given to livestock exclusion systems on perennial streams to achieve the most impact on reducing bacteria loads. However, the use of livestock exclusion practices should also be encouraged on intermittent streams since the TMDL requires stringent reductions of fecal bacteria from direct livestock sources in the impaired Reed Creek tributaries.

Based on data from the VADCR Agricultural BMP database, 18 CRSL-6 practices and106 SL-6 practices have been installed in Wythe County since 1998. Of these, the average length and cost of a CRSL-6 system was 2,143 linear feet and $7,841, respectively. For a SL-6 system, the average length was 1,452 feet and average cost was $12,048. Fourteen LE-1T practices and ten LE-2T practices have been installed in neighboring counties (Grayson, Carroll, Floyd, Giles, Tazewell and Patrick). Of these, the average length and cost of an LE-1T system was 1,097 linear feet and $35,963, respectively. For an LE-2T system, the average length was 1,682 feet and average cost was $9,462. Thirteen WP-2 practices have been installed in the New River Basin (Wythe, Floyd, Montgomery, Pulaski, Giles, and Tazewell Counties) since 2000. Of these, the average length was 1,916 linear feet and the average cost was $5,977. Using this information for this project, an LE-1T system and a CRSL-6 system were defined as having 1,600 feet of fencing and cost of $20,000. An LE-2T system was defined as having 1,800 feet of fencing and cost of $15,000. An SL-6T system was defined as having 1,600 feet of fencing and cost of $25,000. A WP-2T system was defined as having 1,900 linear feet and cost of $6,000.

5.2.2. Pasture

Runoff from pasture is a source of bacteria loads. Bacteria loads to pasture areas come from grazing livestock, the spreading of stored manure, and wildlife. After accounting for load

reductions from currently installed control measures, load reductions resulting from filtering effects of buffers associated with livestock exclusion fencing were quantified. Participants in the agricultural and residential work group felt that rotational grazing would be beneficial in the watershed and farmers were likely to implement this practice. Therefore, improved pasture management was included on pasture acreage as a companion to livestock exclusion control measures. The Environmental Quality Incentives Program (EQIP), a voluntary program offered by NRCS, provides financial and technical assistance for improved pasture management under the EQIP 512 (Pasture and Hayland Planting) and EQIP 528 (Prescribed Grazing) practices. Load reductions realized by reforestation of erodible pasture land (FR-1) and retention ponds, or water control structures (WP-1), were also quantified to reduce bacteria loads from upland pasture areas. While not quantified in the IP, loafing lot management systems (WP-4B) for beef cattle can also be used to reduce the bacteria load in pasture. It is recommended that the stored manure from loafing lot management systems be applied to hay land rather than applied back to pasture. The control measures needed to meet TMDL load reductions for bacteria from pasture are shown in Table 5-3.

Table 5-3. Agricultural control measure quantities recommended for implementation.

Sub-basin	Livestock Exclusion Fencing (linear feet)					Improved Pasture Management (acres)	Reforestation of Erodible Pasture (acres)	Water Control Structures (acres-treated)
	LE-1T	LE-2T	SL-6T	CRSL-6	WP-2T			
Mill Creek	76,087	15,217	4,058	4,058	2,029	2,150	247	645
Cove Creek	126,604	25,321	6,752	6,752	3,376	-	-	-
Miller Creek	34,016	6,803	1,814	1,814	907	-	-	-
Stony Fork	48,320	9,664	2,577	2,577	1,288	1,795	205	628
Tate Run	83,494	16,699	4,453	4,453	2,226	3,352	381	1,173
South Fork Reed Creek	127,962	25,592	6,825	6,825	3,412	5,105	560	1,881
Reed Creek(headwaters to Stony Fork)	56,399	11,280	3,008	3,008	1,504	-	-	-
Reed Creek (Stony Fork to South Fork Reed Creek)	28,726	5,745	1,532	1,532	766	-	-	-
Reed Creek (South Fork Reed Creek to New River)	27,555	5,511	1,470	1,470	735	-	-	-
Total	**609,163**	**121,832**	**32,489**	**32,489**	**16,243**	**12,402**	**1,393**	**4,327**

Based on data from the VADCR Agricultural BMP database, 19 FR-1 practices have been installed in Wythe County since 1998. Of these, the average cost per acre is $126.21. For this project, the cost of the FR-1 practice was calculated as $175/acre to plant conifers and $250/acres to plant hardwood trees. It is assumed that half of the acres will be planted in conifers and the other half in hardwood trees, with an average cost of this practice as $212.50/acre. No WP-1 practices have been recorded for Wythe County or the neighboring counties, 57 practices have been installed in the state since 1998 with an average cost of $842.73 per acre treated. For this project the cost of the WP-1 practice was calculated as $1,000/acre-treated.

5.2.3. Cropland

Runoff from cropland is also a source of bacteria loads. Bacteria loads to the land come from the spreading of stored manure and from wildlife. Bacteria from manure can be reduced either by source reduction or filtering measures (buffers). Although the TMDL does not call for a reduction to the bacteria load on cropland, it was noted during the agricultural and residential work group meeting that if there is any conventional-till cropland receiving manure in the watershed, a continuous no-till system (SL-15A) should be implemented. Cover crops (SL-8B) should also be used in the watershed to maintain a vegetative cover on cropland over the winter.

5.2.4. Residential

According to the TMDL report, the estimated percentage of the total unsewered population with failing septic systems and straight pipes in the Reed Creek watersheds were 21.6% and 0.9%, respectively. The TMDLs call for the removal of all straight pipes in the impaired watersheds in order to meet the TMDL load reductions. Addressing failing septic systems will reduce the bacteria load from residential runoff. Based on a review of TMDL Implementation Plans for impaired streams in neighboring counties (Floyd, Montgomery, Pulaski, Tazewell, and Washington) it was assumed that 25% of failing septic systems could be repaired without installing a new system. Of those failing systems needing to be replaced, it was estimated that 25% would need to be replaced with alternative waste treatment systems and the remainder replaced with a conventional septic system. It is also assumed that 75% of straight pipe corrections will be conventional septic systems and 25% will be alternative waste treatment systems. Table 5-4 gives a summary of control measures estimated to remediate this source of bacteria. In addition to these control measures, an educational effort that targets septic system awareness and basic maintenance will be important for successful implementation.

Table 5-4. Septic System wastewater control measures targeting estimated failing septic systems and straight pipes.

Sub-basin	Estimated Straight Pipes	Estimated Failing Septic Systems	Septic System Repair	Installation of Conventional Septic System	Installation of Alternative Waste Treatment System
Mill Creek	2	59	15	35	11
Cove Creek	2	58	15	34	11
Miller Creek	3	68	17	40	14
Stony Fork	1	57	14	33	11
Tate Run	5	112	28	67	22
South Fork Reed Creek	7	149	37	89	30
Reed Creek(headwaters to Stony Fork)	0	32	8	18	6
Reed Creek (Stony Fork to South Fork Reed Crk)	5	108	27	64	22
Reed Creek (South Fork Reed Crk to New River)	18	428	107	254	85
Total	**43**	**1071**	**268**	**634**	**212**

Septic tank pump-outs were discussed at the Agricultural and Residential Work Group meeting. The consensus was that some residents in unsewered houses would volunteer to schedule pump-outs if they were made aware of the necessity and benefits of septic pump-outs. A septic tank pump-out can be used as a first step in identifying failing septic systems in the watershed. There are also areas in the Reed Creek watershed that provide the potential for connecting to a public sewer system. This alternative should also be considered when available to replace a straight pipe or failing septic system.

Cost share assistance is provided for the above-mentioned residential BMPs. These practices include Septic Tank Pump-out (RB-1), the Connection of Malfunctioning On-site Sewage Disposal System or Straight Pipe to Public Sewer (RB-2), Septic Tank System Repair (RB-3), Septic Tank System Installation/Replacement (RB-4), Septic Tank System Installation/Replacement with Pump (RB-4P), and Alternative On-Site Waste Treatment Systems (RB-5).

5.3. Technical Assistance Needs

Technical assistance is needed for design and installation of selected control measures, as well as for educational outreach. An average of one full-time-equivalent (FTE) employees per year for the 15 year implementation period is needed to address agricultural issues. Residential technical assistance requires one FTE per year for the first 10 years. These estimates were based on similar projects, experience, and recommendation from VADCR. Educational outreach will include strategies identified by stakeholders for facilitating installation and execution of implementation actions.

5.4. Education and Outreach

Staffs from the Big Walker SWCD and NRCS have already been contacting farmers in the watershed providing outreach, technical and financial assistance to farmers to encourage the installation of agricultural BMPs. Both Work Groups were in favor of encouraging landowners who are feeding livestock next to a stream in wintertime to relocate their feeding operation and manure storage; and facilitating neighbor-to-neighbor communication and interaction through field days, Ruritan and Rotary presentations and other methods.

The Agricultural and Residential Work Group suggested that an outreach campaign could be presented to or through organizations such as Ruritan Clubs, churches, and schools to educate homeowners of the possibility of failing septic systems. The Wytheville Farmers Market was also named as a venue for promoting the benefits of improving Reed Creek's water quality.

Putting up information booths or sponsoring bingo night at local fire halls and schools was also suggested as an innovative outreach method. The school system was identified as a commonality where many homeowners and renters could be reached either through their children's school programs, "back to school" nights, Parent Teacher Association (PTA) service announcements and other methods.

5.5. Cost/Benefit Analysis

5.5.1. Costs

The extent/quantity of the agricultural control measures needed to meet the TMDL pollutant reductions are summarized in Table 5-5, together with their unit costs. Unit costs were estimated from the VADCR agricultural BMP database, from TMDL IPs in neighboring counties, and from discussions with Big Walker SWCD. The total estimated cost for full implementation of agricultural control measures in the Reed Creek watersheds is $16,278,193.

Table 5-5. Total cost estimates for agricultural control measures in the Reed Creek watersheds.

Control Measure	Unit	Quantity	Cost/ Unit	Total
Livestock Exclusion – Riparian Buffers (LE-1T)*	system	381	$20,000	$7,620,000
Livestock Exclusion – Reduced Setback (LE-2T)*	system	68	$15,000	$1,020,000
Livestock Exclusion – Riparian Buffers w/ Hardened Pad (SL-6T)*	system	21	$25,000	$525,000
Livestock Exclusion – Riparian Buffers – CREP (CRSL-6)*	system	21	$20,000	$420,000
Livestock Exclusion – Riparian Buffers w/ No Water System (WP-2T)*	system	9	$6,000	$54,000
Improved Pasture Management (EQIP 528, EQIP 512)	acre	12,402	$90	$1,116,180
Reforestation of Erodible Pasture (FR-1)	acre	1,393	$212.50	$296,013
Water Control Structures (WP-1)	acres-treated	4,327	$1,000	$4,327,000
Technical Assistance	person-years	15	$60,000	$900,000
Total				**$16,278,193**

* estimate includes BMP-defined components and component costs.

The needed residential control measures and their costs are summarized in Table 5-6. Typical costs in the region show that a septic system repair costs an estimated $3,500, a conventional septic system is estimated at $6,000, and an alternative waste treatment system is estimated at $15,000 to replace a failing septic system or straight pipe. The total estimated cost for full implementation of residential control measures in the Reed Creek watersheds is $8,522,000.

Table 5-6. Total cost estimates for residential control measures in the Reed Creek watersheds.

Control Measure	Estimated no. of systems needed	Cost/system	Total Cost
Replacing Straight Pipes			
Conventional Septic System	32	$6,000	$192,000
Alternative Waste Treatment System	11	$15,000	$165,000
Repairing Failing Septic Systems	268	$3,500	$938,000
Replacing Failing Septic Systems			
Conventional Septic System	602	$6,000	$3,612,000
Alternative Waste Treatment System	201	$15,000	$3,015,000
Technical Assistance (person-years)	10	$60,000	$600,000
Total			**$8,522,000**

5.5.2. Benefits

It is hard to gage the impact that reducing fecal contamination will have on public health, as most cases of waterborne infection are not reported or are falsely attributed to other sources. However, because of the reductions required, the incidence of infection from fecal sources through contact with surface waters should be reduced considerably.

The primary benefit of implementation is improving water quality in Virginia by reducing the fecal contamination in the Reed Creek watersheds. Many of the control measures intended to reduce bacteria also increase infiltration, which will decrease peak flows downstream.

During implementation planning, it is important to recognize that healthy waters improve economic opportunities for Virginians and a healthy economic base provides the resources and funding necessary to pursue restoration and enhancement activities. The agricultural and residential practices recommended in this document will provide economic benefits to the community, as well as the expected environmental benefits.

Specifically, alternative (clean) water sources, exclusion of cattle from streams, improved pasture management, and private sewage system maintenance will each provide economic benefits to land owners. Money spent by landowners and state agencies in the process of implementing this plan will stimulate the local economy.

A clean water source has been shown to improve weight gain and milk production in cattle. Fresh clean water is an essential requirement for healthy livestock, with healthy cattle consuming, on a daily basis, close to 10% of their body weight during winter and 15% of their

body weight in summer. Many livestock illnesses can be spread through contaminated water supplies. For instance, coccidia can be delivered through feed, water and haircoat contamination with manure (VCE, 2000). In addition, horses drinking from marshy areas or areas where wildlife or cattle carrying Leptospirosis have access tend to have an increased incidence of moonblindness associated with Leptospirosis infections (VCE, 1998a). Some farmers have also noticed decreased leg injuries in livestock from crossing steep or muddy stream banks (Zeckoski *et al.*, 2007). A clean water source can prevent illnesses that reduce production and incur the added expense of avoidable veterinary bills.

In addition to reducing the likelihood of animals contracting waterborne illnesses by providing a clean water supply, streamside fencing excludes livestock from wet, swampy environments as are often found next to streams where cattle have regular access. Keeping cattle in clean, dry areas has been shown to reduce the occurrence of mastitis and foot rot. Installation of streamside fencing and well managed loafing areas will reduce the amount of time that cattle have access to wet, muddy areas.

Implementing an improved pasture management system in conjunction with installing clean water supplies will also provide economic benefits for the producer. Improved pasture management can allow a producer to feed less hay in winter months, and consequently, improve the profitability of the operation. With feed costs typically responsible for 70 to 80% of the cost of growing or maintaining an animal, and pastures providing feed at a cost of 0.01 to 0.02 cents/lb of total digestible nutrients (TDN) compared to 0.04 to 0.06 cents/lb TDN for hay, increasing the amount of time that cattle are fed on pasture is clearly a financial benefit to producers (VCE, 1996). Standing forage utilized directly by the grazing animal is always less costly and of higher quality than the same forage harvested with equipment and fed to the animal. Distributed off-stream waterers and cross-fencing can also improve forage utilization and manure nutrient distribution throughout a pasture (Zeckoski *et al.*, 2007). Another benefit is that, at any given time cattle are in a smaller area, facilitating inspection and handling. The agricultural BMPs recommended in this document will provide both environmental benefits and economic benefits to the farmer.

The residential pollutant control measures discussed herein will play an important role in improving water quality, since human waste can carry with it human viruses in addition to the bacterial and protozoan pathogens that all fecal matter potentially carry. An improved understanding of on-site sewage treatment systems, including knowledge of what steps can be

taken to keep them functioning properly, will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. The average septic system will last 20 to 25 years, if properly maintained. Proper maintenance includes: knowing the location of the system components and protecting them (e.g., not driving or parking on top of them), not planting trees in locations where roots could damage the system, keeping hazardous chemicals out of the system, and pumping out the septic tank every 3 to 5 years. The cost of proper maintenance, as outlined here, is relatively inexpensive in comparison to repairing or replacing an entire system. Additionally, if the repair/replacement and pump-out programs become available, they will benefit owners of private sewage (e.g., septic) systems, particularly low-income homeowners, by sharing the cost of required maintenance.

In addition to the benefits to individual landowners, the economy of the local community will be stimulated through expenditures made during implementation, and the infusion of dollars from funding sources outside the impaired areas. Building contractors and material suppliers who deal with septic system pump-outs, private sewage system repair and installation, fencing, and other BMP components can expect to see an increase in business during implementation. Additionally, income from maintenance of these systems should continue long after implementation is complete. A portion of the funding for implementation can be expected to come from state and federal sources. This portion of funding represents money that is new to the area and will stimulate the local economy. In general, implementation will provide not only environmental benefits to the community, but economic benefits as well, which, in turn, will allow for individual landowners to participate in implementation.

6. MEASURABLE GOALS AND MILESTONES

6.1. Implementation Goals

The goals of TMDL implementation are to restore the water quality in the impaired stream segments in the Reed Creek watersheds so that they comply with water quality standards and to de-list these segments from the Commonwealth of Virginia's 303(d) List of Impaired Waters. Progress towards these goals can be assessed during the implementation process by tracking the number/type of control measures that are installed and programs or policies developed and executed (implementation actions) and continued water quality monitoring. Improvements in water quality will be measured through monitoring of bacteria concentrations throughout the watersheds.

6.2. Implementation Milestones and Water Quality Goals

The implementation of control measures will be accomplished in stages. In general, the Commonwealth intends that the needed control measures be implemented in a progressive process that first addresses the pollutant sources with the largest impact on water quality. This staged approach is based on meeting water quality goals over a fifteen-year period.

Once the implementation milestones and stages are established, the water quality improvement that should result from achieving each milestone can be predicted. The bacteria violations that result from each implementation milestone were estimated by using the modeling files that were developed during the TMDL process.

The TMDL report lists an interim set of Stage 1 goals for bacteria load reductions and will serve as a guideline for the first implementation milestone at the 10-year mark. These goals are summarized in Table 3-7. Implementation of Stage 1 control measures is expected to reduce the bacteria loadings from controllable sources so that violations of the single sample maximum *E. coli* criterion (235 cfu/100mL) are less than 10.5%.

Table 6-1 lists the residential control measures and Table 6-2 lists the agricultural control measures that are scheduled to be implemented in Stage 1. In addition to the Stage 1 livestock exclusion reductions cited in the TMDL report (Table 3-7) for the Reed Creek tributaries, VADCR recommended that some of the livestock exclusion fencing practices needed on the main stem of Reed Creek to meet the water quality standard be implemented in Stage 1. VADCR also recommended the inclusion of pasture management in the Reed Creek watershed during Stage 1 as it complements the livestock exclusion practices being installed. Therefore,

improved pasture management is prescribed in Stage 1 for 25% of the pasture acres targeted for this practice. Local SWCD personnel have already started working with producers in the watersheds to install agricultural BMPs. The agricultural BMPs needed to achieve Stage 2 are summarized in Table 6-3. These 'Stage 2' control measures will be installed during the 5-year period following Stage 1. Table 6-4 shows the costs associated with Stage 1 and Stage 2 implementation efforts. The exceedances of the *E. coli* criteria at Stage 1 and Stage 2 are listed in Table 6-5.

Table 6-1. Residential Control Measures to meet Stage 1 Implementation Milestones for Reed Creek.

Sub-basin	Replace Straight Pipes	Repair Failing Septic Systems	Replace Failing Septic Systems
Mill Creek	2	15	44
Cove Creek	2	15	43
Miller Creek	3	17	51
Stony Fork	1	14	43
Tate Run	5	28	84
South Fork Reed Creek	7	37	112
Reed Creek headwaters to Stony Fork)	0	8	24
Reed Creek (Stony Fork to South Fork Reed Creek)	5	27	81
Reed Creek (South Fork Reed Creek to New River)	18	107	321
Total	**43**	**268**	**803**

Table 6-2. Agricultural Control Measures to meet Stage 1 Implementation Milestones for Reed Creek.

Sub-basin	Streams‡ needing Fencing (%)	No. of Livestock Exclusion LE-1T systems	No. of Livestock Exclusion LE-2T systems	No. of Livestock Exclusion SL-6T systems	No. of Livestock Exclusion CRSL-6 systems	No. of Livestock Exclusion WP-2T systems	Improved Pasture Management (acres)
Mill Creek	95	46	8	3	3	1	537
Cove Creek	85	67	12	3	3	2	-
Miller Creek	95	21	4	1	1	1	-
Stony Fork	95	28	5	2	2	1	449
Tate Run	100	52	9	3	3	1	838
South Fork Reed Creek	90	72	13	4	4	2	1276
Reed Creek (headwaters to Stony Fork)	40	14	2	1	1	0	-
Reed Creek (Stony Fork to South Fork Reed Creek)	30	5	1	0	0	0	-
Reed Creek (South Fork Reed Creek to New River)	5	1	0	0	0	0	-
Total		**306**	**54**	**17**	**17**	**8**	**3,100**

‡ Streams with pasture access.

Table 6-3. Reed Creek Stage 2 Agricultural Control Measures.

Sub-basin	Streams‡ needing Fencing (%)	No. of Livestock Exclusion LE-1T systems	No. of Livestock Exclusion LE-2T systems	No. of Livestock Exclusion SL-6T systems	No. of Livestock Exclusion CRSL-6 systems	No. of Livestock Exclusion WP-2T systems	Pasture Reductions (%)	Improved Pasture Management (acres)	Reforestation of Erodible Pasture (acres)	Water Control Structures (acres-treated)
Mill Creek	100	2	1	0	0	0	85	1,613	247	645
Cove Creek	100	12	2	1	1	0	0	-	-	-
Miller Creek	100	1	0	0	0	0	0	-	-	-
Stony Fork	100	2	1	0	0	0	90	1,346	205	628
Tate Run	100	0	0	0	0	0	95	2,514	381	1,173
South Fork Reed Creek	100	8	1	0	0	0	55	3,829	560	1,881
Reed Creek (headwaters to Stony Fork)	90	21	4	1	1	1	0	-	-	-
Reed Creek (Stony Fork to South Fork Reed Creek)	65	13	2	1	1	0	0	-	-	-
Reed Creek (South Fork Reed Creek to New River)	15	16	3	1	1	0	0	-	-	-
Total		**75**	**14**	**4**	**4**	**1**		**9,302**	**1,393**	**4,327**

‡ Streams with pasture access.

Table 6-4. Staged Implementation Costs for Reed Creek.

Type of Control Measure	Implementation Costs		
	Stage 1 (10 years)	Stage 2 (5 years)	Total
Livestock Exclusion Measures			
LE-1T systems	$6,120,000	$1,500,000	$7,620,000
LE-2T systems	$810,000	$210,000	$1,020,000
CRSL-6 systems	$340,000	$80,000	$420,000
SL-6T systems	$425,000	$100,000	$525,000
WP-2T systems	$48,000	$6,000	$54,000
Pasture Control Measures			
improved pasture management	$279,000	$837,180	$1,116,180
reforestation of erodible pasture	-	$296,013	$296,013
water control structures	-	$4,327,000	$4,327,000
Residential Wastewater Control Measures			
conventional septic systems	$3,804,000	-	$3,804,000
alternative waste treatment systems	$3,180,000	-	$3,180,000
septic system repairs	$938,000	-	$938,000
Technical Assistance			
agricultural BMPs	$600,000	$300,000	$900,000
residential BMPs	$600,000	-	$600,000
Total	$17,144,000	$7,656,193	$24,800,193

Table 6-5. Percent exceedances of the single sample maximum *E. coli* criterion (235 cfu/100mL) and the 30-day geometric mean criterion (126 cfu/100 mL) at Stage 1 and Stage 2 of implementation.

Sub-basin	Stage 1		Stage 2	
	Single Sample	Geometric Mean	Single Sample	Geometric Mean
Mill Creek	8%	15%	1%	6%
Cove Creek	9%	19%	5%	0%
Miller Creek	8%	8%	5%	0%
Stony Fork	8%	14%	1%	6%
Tate Run	8%	6%	1%	3%
South Fork Reed Creek	10%	26%	4%	0%
Reed Creek N10R_RDC01B00	6%	15%	2%	0%
Reed Creek N10R_RDC01A02	6%	17%	2%	0%
Reed Creek N10R_RDC01A00	7%	18%	3%	0%
Reed Creek N11R_RDC01B00	6%	17%	4%	0%
Reed Creek N11R_RDC02B02	6%	14%	5%	0%
Reed Creek N11R_RDC03B04	6%	14%	5%	0%

Two types of milestones will be used to evaluate progress over the 15 year period. Implementation milestones establish the fraction of implementation actions to be taken within certain timeframes. Water quality goals establish the corresponding improvements in water quality that can be expected as the implementation milestones are achieved.

Many implementation activities are already underway in the watersheds. These activities are strongly supported and the recommendation from the Reed Creek Work Groups is a continuation of those efforts that are complementary to this plan.

The Work Groups also support prioritizing the placement of implementation practices to critical areas during Stage 1 to achieve the greatest impact in water quality in the shortest amount of time. Since 100% of livestock exclusion needs to occur in Tate Run during Stage 1, priority should be given to this watershed during Stage 1 (sub-watersheds 34 – 36, Figure 3-3). In addition, watershed inventory and modeling efforts suggest prioritizing Miller Creek sub-watersheds 13 – 16; Stony Fork sub-watersheds 49 – 54, and Mill Creek sub-watersheds 59 – 63 for livestock exclusion practices. Bacterial loads from residential sources located close to a stream are highest in Reed Creek sub-watersheds 6, 11, 17, and 46; Tate Run sub-watersheds 35 and 36; and South Fork Reed Creek sub-watersheds 38 and 42.

Monitoring will begin after BMPs have been established and serves to document progress towards goals and to provide a mechanism for evaluating the effectiveness of the implementation actions for achieving intended water quality goals. The benefits of staged implementation are 1) as stream monitoring continues, it allows for water quality improvements to be recorded as they are being achieved; 2) it provides a measure of quality control, given the uncertainties which exist in any implementation plan; 3) it provides a mechanism for developing public support; 4) it helps to ensure that the most cost-effective practices are implemented initially; and 5) it allows for the evaluation of the adequacy of the TMDL in achieving the water quality standard.

6.3. Reasonable Assurance

Public participation is an integral part of the IP development and is critical in gaining support for both the voluntary implementation activities that are being planned. During the public participation process, the major stakeholders in the watershed and a wide variety of local conservation agency personnel were involved in Work Groups and public meetings, and provided additional information through email and phone conversations. This participation by the major watershed stakeholders provides a reasonable assurance that the public was contributing

to the TMDL process and had input into the selection of management and implementation practices recommended by this IP.

A TMDL IP Steering Committee will be formed as a result of the implementation plan to provide oversight for implementation as needed, with guidance provided by agency members of VADEQ and VADCR, ensuring continuity of leadership and vision. Conservation Technicians are already on staff in the Big Walker SWCD to assist agricultural producers in implementing BMPs. The Conservation Technicians have agreed to take responsibility for promoting both agricultural and residential implementation practices within the watersheds.

Implementation to address the bacteria impairments on Reed Creek will be carried out primarily through the use of voluntary BMPs and education. Available cost-share programs will be utilized to the extent possible to provide incentives to targeted watershed stakeholders. The Steering Committee is encouraged to seek grant funding to provide additional monies to increase participation from stakeholders that would otherwise be reticent to participate.

Taken together, all of these planning components comprise a reasonable assurance that implementation will progress as planned and will lead to restoration of water quality in Reed Creek.

6.4. Implementation Tracking

Tracking of agricultural and residential practices will be done by the Big Walker SWCD through the existing BMPCSP tracking maintained by VADCR. Tracking information will include the locations and numbers of practices installed in the watershed. Strategies to facilitate implementation, such as educational programs and other outreach activities will also be tracked. The Steering Committee will provide oversight and direction as needed during implementation.

6.5. Water Quality Monitoring

Virginia's 1997 Water Quality Monitoring, Information and Restoration Act requires that TMDL IPs include measurable goals and milestones for attaining water quality standards. Implicit in those milestones is the requirement of a method to measure progress. Water quality improvement will be evaluated through water quality monitoring conducted by VADEQ. VADEQ will monitor eleven locations in the watersheds (Table 6-6, Figure 6-1). These ambient watershed stations will be sampled in accordance with the ambient monitoring schedule. Prior to TMDL development, these stations were monitored every other month during 2009 and 2010. They will rotate off the monitoring schedule until 2015 and 2016 at which time they will again be monitored every other month for two years. VADEQ will collect water quality data at each

station, including, but not be limited to, the following parameters: *E. coli* bacteria, temperature, dissolved oxygen, and specific conductance. The Government Work Group also discussed the possibility of adding citizen monitoring during the first 5 years of implementation in order to help show progress toward water quality improvements.

Table 6-6. VADEQ Monitoring Stations in the Reed Creek Watersheds.

VADEQ Station ID	Stream Name	Station Location
9-MCE000.37	Mill Creek	Bridge #6049 on Rt. 647
9-RSF000.08	South Fork Reed Creek	Off Rt. 667 on Avery Lane
9-SFK000.28	Stony Fork	Bridge #6187 on Rt. 664
9-TAT000.46	Tate Run	Bridge #6039 on Rt. 655
9-MER000.09	Miller Creek	Bridge #6197 on Rt. 614
9-CVR003.88	Cove Creek	Bridge #6030 on Rt. 647
9-RDC046.65	Reed Creek	Bridge #6022 on Rt. 625
9-RDC038.01	Reed Creek	Private drive off Rt. 633
9-RDC033.78	Reed Creek	Pull off on Rt. 655
9-RDC009.00	Reed Creek	Rt. 619 at gaging station
9-RDC000.79	Reed Creek	Swinging bridge #9000 on Rt. 618

6.6. Evaluation of Progress

During each periodic evaluation of implementation progress on Reed Creek, a reassessment of implementation priorities will be made by the Steering Committee to readjust and fine-tune the targeting approach in concert with the staged implementation approach. Periodic re-evaluation is especially critical during these times of economic uncertainty, where increasing energy prices and fluctuating market prices are bound to affect stakeholders in the agricultural sector and their willingness to commit resources for conservation, especially if they are struggling to maintain their viability as a farming enterprise.

If reasonable progress toward implementing the management practices is not demonstrated, the Steering Committee will consider additional implementation actions. If it is demonstrated that reasonable and feasible management measures have been implemented for a sufficient period of time and TMDL targets are still not being met, the TMDL will be reevaluated and revised accordingly. If after five years the Steering Committee determines that load reductions are being achieved as management measures are implemented, then the recommended appropriate course of action would be to continue management measure implementation and compliance oversight. If it is determined that all proposed control measures have been implemented, yet the TMDL is not achieved, further investigations will be made to determine whether: 1) the control measures are not effective; 2) bacteria loads are due to sources not previously addressed; or 3) the TMDL is unattainable.

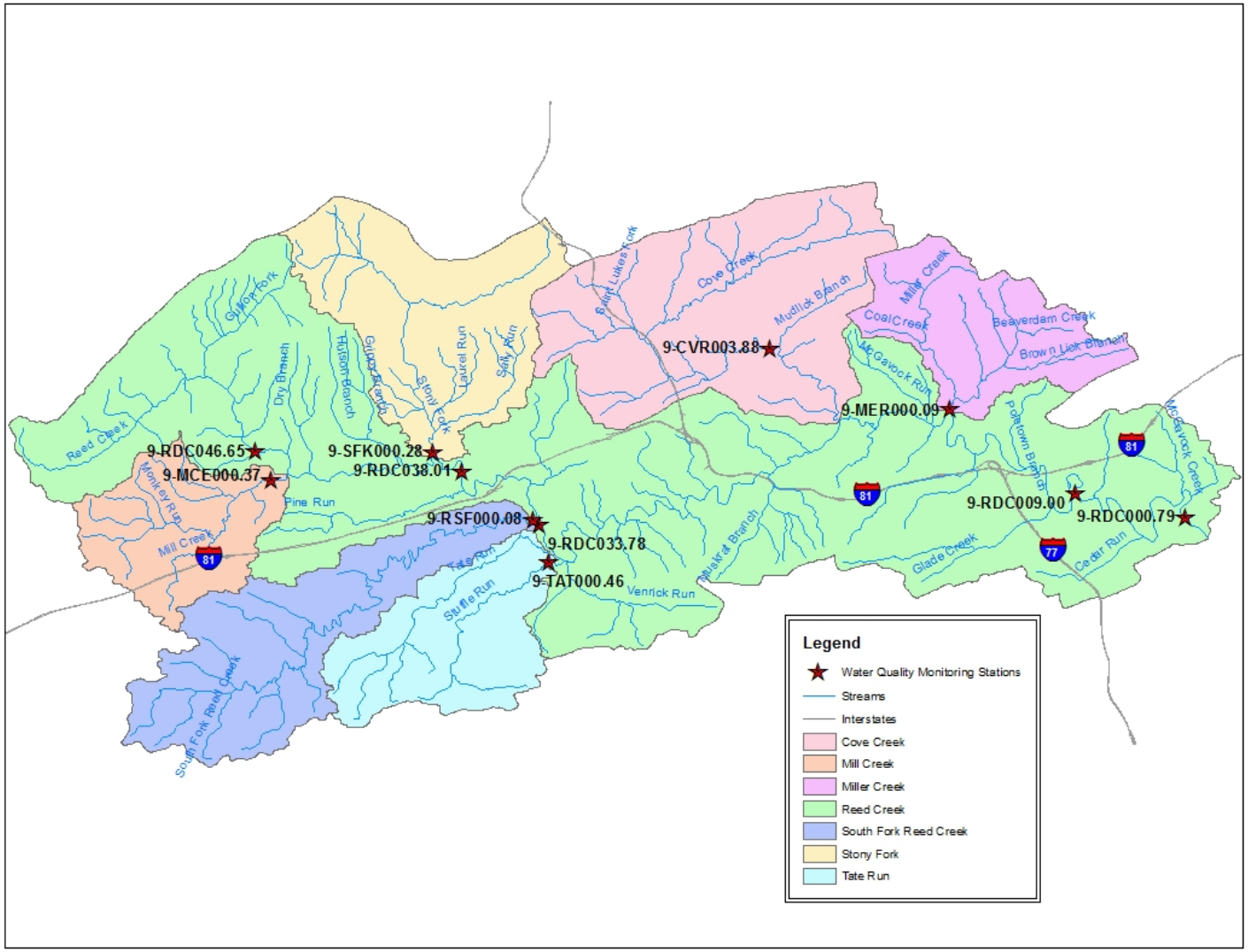

Figure 6-1. Location of Reed Creek TMDL Implementation Monitoring Stations.

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7. STAKEHOLDERS' ROLES AND RESPONSIBILITIES

Stakeholders are individuals who live or have land management responsibilities in the watershed, including government agencies, businesses, private individuals, and special interest groups. Stakeholder participation and support is essential for achieving the goals of this TMDL effort (i.e., improving water quality and removing streams from the impaired waters list). The purpose of this chapter is to identify and define the roles of the stakeholders who will work together to put the IP into practice. The roles and responsibilities of some of the major stakeholders are described below.

7.1. Federal Government

United States Environmental Protection Agency (USEPA): USEPA has the responsibility of overseeing the various programs necessary for the success of the CWA. However, administration and enforcement of such programs falls largely to the states.

Natural Resource Conservation Service (NRCS): The U.S. Department of Agriculture, Natural Resources Conservation Service is the federal agency that works hand-in-hand with US citizens to conserve natural resources on private lands. NRCS assists private landowners with conserving their soil, water, and other natural resources. Local, state and federal agencies and policymakers also rely on the expertise of NRCS staff. NRCS is also a major funding stakeholder for impaired water bodies through CREP and the Environmental Quality Incentive Program (EQIP). For more information on NRCS, visit http://www.nrcs.usda.gov/.

7.2. State Government

In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. Currently, there are five state agencies responsible for regulating and/or overseeing statewide activities that impact water quality in the Reed Creek watersheds.

Virginia Department of Environmental Quality (VADEQ): The State Water Control Law authorizes the State Water Control Board to control and plan for the reduction of pollutants impacting the chemical and biological quality of the State's waters resulting in the degradation of the swimming, fishing, shell fishing, aquatic life, and drinking water uses. For many years the focus of VADEQ's pollution reduction efforts was the treated effluent discharged into Virginia's

waters via the VPDES permit process. The TMDL process has expanded the focus of VADEQ's pollution reduction efforts from the effluent of wastewater treatment plants to the NPS pollutants causing impairments of the streams, lakes, and estuaries. The reduction tools are being expanded beyond the permit process to include a variety of voluntary strategies and BMPs.

VADEQ is the lead agency in the TMDL process. The Code of Virginia directs VADEQ to maintain a list of impaired waters and develop TMDLs for these waters. VADEQ administers the TMDL process, including the public participation component, and formally submits the TMDLs to USEPA and the State Water Control Board for approval. VADEQ is also responsible for implementing point source WLAs, assessing water quality across the state, and conducting water quality standard related actions. The Code also requires the development of IPs for the TMDLs. VADEQ is providing funding for the development of the Reed Creek IP.

Virginia Department of Conservation and Recreation (VADCR): VADCR is authorized to administer Virginia's NPS pollution reduction programs in accordance with §10.1-104.1 of the Code of Virginia and §319 of the CWA. USEPA requires much of the §319 grant monies be used for the development of TMDLs. Because of the magnitude of the NPS component in the TMDL process, VADCR is a major participant in the TMDL process. VADCR has a lead role in the development of IPs to address correction of NPSs contributing to water quality impairments. VADCR also provides available funding and technical support for the implementation of NPS components of IPs. The staff resources in VADCR's TMDL program focus primarily on providing technical assistance and funding to stakeholders to develop and carry out IPs, and support to VADEQ in TMDL development related to NPS impacts. VADCR staff will also be working with other state agencies, Soil and Water Conservation Districts, and watershed groups to gather support and to improve the implementation of TMDL plans through utilization of existing authorities and resources.

Virginia Department of Agriculture and Consumer Services (VDACS): The VDACS Commissioner of Agriculture has the authority to investigate claims that an agricultural producer is causing a water quality problem on a case-by-case basis. If deemed a problem, the Commissioner can order the producer to submit an agricultural stewardship plan to the local soil and water conservation district. If a producer fails to implement the plan, corrective action can be taken, which may include civil penalties. The Commissioner of Agriculture can issue an emergency corrective action if runoff is likely to endanger public health, animals, fish and

aquatic life, public water supply, etc. An emergency order can shut down all or part of an agricultural activity and require specific stewardship measures.

Virginia Department of Health (VDH): The VDH is responsible for maintaining safe drinking water measured by standards set by the USEPA. Like VDACS, VDH is complaint driven. Their duties also include regulation of septic systems, and straight pipes. For TMDLs, VDH has the responsibility of enforcing actions to correct failed septic systems and/or eliminate straight pipes (Sewage Handling and Disposal Regulations, 12 VAC 5-610-10 et seq.). VDH also issues permits for the repair and installation of septic systems and alternative waste treatment systems.

Virginia Department of Forestry (VADOF): The VADOF has prepared a manual to inform and educate forest landowners and the professional forest community on proper BMPs and technical specifications for installation of these practices in forested areas (http://www.dof.virginia.gov/wq/index-BMP-Guide). Forestry BMPs are directed primarily to control erosion. For example, streamside forest buffers provide nutrient uptake and soil stabilization, which can benefit water quality by reducing the amount of nutrients and sediments that enter local streams. VADOF's BMP program is voluntary.

Another state entity with responsibilities for activities that impact water quality in the Reed Creek watersheds is the Virginia Cooperative Extension (VCE). VCE is an educational outreach program of Virginia's land grant universities (Virginia Tech and Virginia State University), and a part of the national Cooperative State Research, Education, and Extension Service, an agency of the United States Department of Agriculture. VCE is a product of cooperation among local, state, and federal governments in partnership with citizens. VCE offers educational programs and technical resources for topics such as crops, grains, livestock, poultry, dairy, natural resources, and environmental management. VCE has published several publications that deal specifically with TMDLs. For more information on these publications and to find the location of county extension offices, visit http://www.ext.vt.edu/.

7.3. Regional and Local Government

Regional and local government groups work closely with state and federal agencies throughout the TMDL process; these groups possess insights about their regional and local community that may help to ensure the success of TMDL implementation. These stakeholders have knowledge about a community's priorities, how decisions are made locally, and how the watershed's

residents interact. Some local government groups and their roles in the TMDL process are listed below.

Big Walker SWCD: Soil and Water Conservation Districts (SWCDs) are local units of government responsible for the soil and water conservation work within their boundaries. The districts' role is to increase voluntary conservation practices among farmers, ranchers and other land users. District staff work closely with watershed residents and have valuable knowledge of local watershed practices.

Wythe County: County government staff members work closely with state agencies to develop and implement TMDLs in concert with their comprehensive plans. They may also help to promote education and outreach to citizens, businesses and developers to introduce the importance of the TMDL process.

7.4. Businesses, Community Groups, and Citizens

While successful implementation depends on stakeholders taking responsibility for their role in the process, the primary role falls on the local groups that are most affected; that is, businesses, community watershed groups, and citizens. Virginia's approach to correcting non-point source pollution problems continues to be encouragement of participation through education and financial incentives; that is, outside of the regulatory framework. If, however, voluntary approaches prove to be ineffective, it is likely that implementation will become less voluntary and more regulatory.

Community Watershed Groups: Local watershed groups (for example, Beagle Ridge chapter of the Virginia Master Naturalists, New River Watershed Roundtable, Inc., Friends of the New River, New River Valley Sierra Club) offer a meeting place for river groups to share ideas and coordinate preservation efforts and are also a showcase site for citizen action. Watershed groups also have a valuable knowledge of the local watershed and river habitat that is important to the implementation process. Active community watershed groups can be a good resource for procuring and distributing grant funds to assist in financing implementation actions. Depending on their missions, they also present opportunities for educating residents and other stakeholders about the TMDL and implementation plan.

Citizens and Businesses: The primary role of citizens and businesses is simply to get involved in the TMDL process. This may include participating in public meetings, assisting with public

outreach, providing input about the local watershed history, and/or implementing BMPs to help restore water quality.

Community Civic Groups: Community civic groups take on a wide range of community service including environmental projects. Such groups include the Ruritan, Farm Clubs, Homeowner Associations and youth organizations such as 4-H and Future Farmers of America. These groups offer a resource to assist in the public participation process, educational outreach, and assisting with implementation activities in local watersheds.

Animal Clubs/Associations: Clubs and associations for various animal groups (e.g., beef, equine, poultry, swine, and canine) provide a resource to assist and promote conservation practices among farmers and other land owners, not only in rural areas, but in urban areas as well, where pet waste has been identified as a source of bacteria in water bodies.

8. INTEGRATION WITH OTHER WATERSHED PLANS

Each watershed within the state is under the jurisdiction of a multitude of individual yet related water quality programs and activities, many of which have specific geographical boundaries and goals. These include, but are not limited to, Total Maximum Daily Loads, water quality management plans (WQMPs), sediment and erosion control regulations, stormwater management (SWM), Source Water Assessment Program (SWAP), and local comprehensive plans.

8.1. Continuing Planning Process

According to Perciasepe (1997) the continuing planning process (CPP) established by Section 303(e) of the CWA provides a good framework for implementing TMDLs, especially the NPS load allocations. Under the Section 303(e) process, states develop and update statewide plans that include TMDL development and adequate implementation of new and revised water quality standards, among other components. The water quality management regulations at 40 CFR 130.6 require states to maintain WQMPs that are used to direct implementation of key elements of the continuing planning process, including TMDLs, effluent limitations, and NPS management controls. These state WQMPs are another way for states to describe how they will achieve TMDL load allocations for NPSs. The CPP in Virginia is implemented in various state programs, all aimed toward achieving and maintaining the state water quality standards. Virginia Code Sections 62.1-44.15(10) & (13), 62.1-44.17:3, and 62.1-44.19:7 give the Virginia State Water Control Board (Board) the duty and authority to conduct the CPP in Virginia. Under the authority of Virginia Code Section 10.1-1183, VADEQ serves as the administration arm of the Board. Virginia WQMPs consist of initial plans produced in accordance with Sections 208 and 303(e) of the CWA and approved updates to the plans. Currently, Virginia has a total of 18 WQMPs developed under Sections 208 and 303(e). Many of these plans are outdated, and efforts are underway to update them. The updated plans will serve as repositories for all TMDLs approved by USEPA and adopted by the Board, as well as IPs approved by the Board.

8.2. Watershed and Water Quality Management Planning Programs in Virginia

TMDLs – TMDLs are the maximum amount of pollutant that a water body can assimilate without surpassing state water quality standards. TMDLs are developed for water bodies that are listed on a state's 303(d) list, known as the "Impaired Waters List." The TMDL develops a waste load allocation for point sources and a load allocation for NPSs and incorporates a "margin of safety" in defining the assimilation capacity of the water body. The IP outlines strategies to meet the allocations.

WQMPs – Water Quality Management Plans (WQMPs) are produced and updated by VADEQ in accordance with Sections 208 and 303(e) of the CWA as outlined in the CPP section above. These plans will be the repository for TMDLs and TMDL IPs.

SWM – Stormwater Management (SWM) programs are implemented according to the Virginia Stormwater Management Law and Virginia Stormwater Management Regulations (VSWML&R). These statutes are specifically set forth regarding land development activities to prevent water pollution, stream channel erosion, depletion of ground water resources, and more frequent localized flooding to protect property values and natural resources. SWM programs operated according to the law are designed to address these adverse impacts and comprehensively manage the quality and quantity of stormwater runoff on a watershed-wide basis. VADCR oversees regulated activities undertaken on state and federal property. Revisions to the Virginia SWM Regulations require most Virginia localities to operate their own local SWM program. Only towns without an MS4 program have the option of administering their SWM program or having development regulated by the surrounding county. For more information, visit http://www.dcr.virginia.gov/stormwater_management/stormwat.shtml.

SWAP – Section 1453 of the 1986 Amendments of the Safe Drinking Water Act (SDWA) requires each state to develop a Source Water Assessment Plan (SWAP) that will delineate the boundaries of the assessment areas from which public water systems receive drinking water using hydrogeologic information, water flow, recharge, and discharge and other reliable information. The VDH is the primary agency for drinking water and is therefore responsible for SWAP. In Virginia, all 187 surface water intakes serving 151 public waterworks have completed

surface water assessments. All 4,584 ground water source assessments, serving nearly 4,000 public waterworks, were completed by the end of 2003.

Local Comprehensive Plans – (Wythe County) Virginia state law requires all local governments have an adopted comprehensive plan. Typical topics addressed in a comprehensive plan include the analysis of population change, land use and trends, natural and environmental features, transportation systems, and community facilities and services. Local comprehensive plans should be referred to in the TMDL development process as well as TMDL implementation, especially for urbanized watersheds.

9. POTENTIAL FUNDING SOURCES

Clean Water State Revolving Fund – USEPA awards grants to states to capitalize their Clean Water State Revolving Funds (CWSRFs). The states, through the CWSRF, make loans for high-priority water quality activities. As loan recipients make payments back into the fund, money is available for new loans to be issued to other recipients. Eligible projects include point source, NPS, and estuary protection projects. Point source projects typically include building wastewater treatment facilities; combined sewer overflow and sanitary sewer overflow correction; urban stormwater control; and water quality aspects of landfill projects. NPS projects include agricultural, silviculture, rural, and some urban runoff control; on-site wastewater disposal systems (septic tanks); land conservation and riparian buffers; leaking underground storage tank remediation, etc.

Conservation Reserve Enhancement Program – The Conservation Reserve Enhancement Program (CREP) is a voluntary land retirement program that helps agricultural producers protect environmentally sensitive land, decrease erosion, restore wildlife habitat, and safeguard ground and surface water. CREP is an offshoot of the country's largest private-lands environmental improvement program -- the Conservation Reserve Program (CRP). Like CRP, CREP is administered by USDA's Farm Service Agency (FSA). CREP addresses high-priority conservation issues of both local and national significance, such as impacts to water supplies, loss of critical habitat for threatened and endangered wildlife species, soil erosion, and reduced habitat for fish populations such as salmon. CREP is a community-based, results-oriented effort centered on local participation and leadership. CREP contracts require a 10- to 15-year commitment to keep lands out of agricultural production. A federal annual rental rate, including an FSA state committee-determined maintenance incentive payment, is offered, plus cost-share of up to 50 percent of the eligible costs to install the practice.

Environmental Quality Incentives Program – The USDA Natural Resources Conservation Service's Environmental Quality Incentives Program (EQIP) was established to provide a voluntary conservation program for farmers and ranchers to address significant natural resource needs and objectives. EQIP offers financial and technical help to assist eligible participants install or implement structural and management practices on eligible agricultural land.

EPA Section 319 Grant Incremental Funds – Through Section 319 of the Federal CWA, Virginia is awarded grant funds to implement NPS programs. The VADCR administers the money

annually on a competitive grant basis to fund watershed projects, demonstration and educational programs, NPS pollution control program development, and technical and program staff including TMDL Implementation.

Landowner Incentive Program (Non-Tribal) – The U.S. Fish and Wildlife Service's Landowner Incentive Program (LIP) grant program provides competitive matching grants to states, territories, and the District of Columbia to establish or supplement landowner incentive programs. LIP is a grant-based voluntary cost-share program administered by Virginia Department of Game and Inland Fisheries. These programs provide technical and financial assistance to private landowners for projects that protect and restore habitats of listed species or species determined to be at-risk. LIP projects will likely involve activities such as the restoration of marginal farmlands to wetlands, the removal of exotic plants to restore natural prairies, a change in grazing practices and fencing to enhance important riparian habitats, instream structural improvements to benefit aquatic species, road closures to protect habitats and reduce harassment of wildlife, and acquisition of conservation easements. Although not directly eligible for these grants, third parties such as nonprofit organizations may benefit from these funds by working directly with their states to see if either grants or partnering opportunities are available. Private landowners within the New River Basin (including Reed Creek, and all tributaries) are eligible for program benefits.

National Fish and Wildlife Foundation – Grant proposals for this funding are accepted throughout the year and processed during fixed sign up periods. There are two decision cycles per year. Each cycle consists of a pre-proposal evaluation, a full proposal evaluation, and a Board of Directors' decision. Grants generally range between $10,000 and $150,000. Grants are awarded for the purpose of conserving fish, wildlife, plants, and their habitats. Special grant programs are listed and described on the NFWF website (http://www.nfwf.org). If the project does not fall into the criteria of any special grant programs, a proposal may be submitted as a general grant if it falls under the following guidelines: 1) it promotes fish, wildlife and habitat conservation, 2) it involves other conservation and community interests, 3) it leverages available funding, and 4) project outcomes are evaluated.

Southeast Rural Community Assistance Project (Southeast RCAP) – The mission of this project is to promote, cultivate, and encourage the development of water and wastewater facilities to serve low-income residents at affordable costs and to support other development activities that will improve the quality of life in rural areas. Staff members of other community organizations

complement the Southeast RCAP central office staff across the region. They can provide (at no cost to a community): on-site technical assistance and consultation, operation and maintenance/management assistance, training, education, facilitation, volunteers, and financial assistance. Southeast RCAP also has a state-funded Indoor Plumbing and Rehabilitation Program to help with interior plumbing upgrades for low-income rural residents. For more information, visit http://www.southeastrcap.org.

Virginia Aquatic Resources Trust Fund (VARTF) – The Virginia Aquatic Resources Trust Fund is administered in partnership with The Nature Conservancy in Virginia, the VADEQ, and the United States Army Corps of Engineers Norfolk District. The Trust Fund helps make large-scale conservation possible. The program is able to implement large-scale watershed efforts that restore, enhance, and protect water quality through cost-effective, ecologically preferable projects.

Virginia Agricultural Best Management Practices Cost-Share Program – The Virginia Agricultural Best Management Practices (BMPs) Cost-Share Program provides funds to help install conservation practices that protect water and make farms more productive. Funding availability varies by SWCD. The state provides SWCDs with funds to target areas with known water quality needs. Areas with the greatest need receive the greatest funding. The cost-share program supports using various practices in conservation planning to treat animal waste, cropland, pastureland and forested land. Some are paid for at a straight per-acre rate. Others are cost-shared on a percentage basis up to 85 percent. In some cases, USDA also pays a percentage. In fact, the cost-share program's practices can often be funded by a combination of state and federal funds, reducing the landowner's expense to less than 30 percent of the total cost. Cost-share funds are also available for approved innovative BMP demonstration projects intended to improve water quality.

Virginia Agricultural Best Management Practices Loan Program – The Virginia Agricultural Best Management Practices Loan Program provides a source of low interest financing which will encourage the use of specific best management practices which reduce or eliminate the impact of Agricultural Nonpoint Source (NPS) pollution to Virginia's waters. VADEQ's Virginia Ag BMP loan program is a subset of the parent Virginia Clean Water Revolving Loan Fund (VCWRLF) loan program and is intended to create a continuing source of low interest financing that will be available to Virginia's agricultural producers to assist them in their efforts to reduce agricultural non-point source pollution. Unlike other assistance programs, the Ag BMP loan program is not

dependent on legislative appropriations for its fund availability. All repayments of principle and interest from previous Ag BMP loans are returned to the Fund and used to provide additional loans to other Virginia farmers. In addition to the revenue available from repayments, VADEQ will request that the State Water Control Board (SWCB) consider making additional funding set-asides from the VCWRLF revenue as deemed necessary in order to meet Virginia's agricultural non-point source pollution reduction needs.

Virginia Agricultural Best Management Practices Tax Credit Program - For all taxable years, any individual or corporation, who is engaged in agricultural production for market and who has in place a soil conservation plan approved by the local SWCD, is allowed a credit against the tax imposed by Section 58.1-320 of an amount equaling 25% of the first $70,000 expended for agricultural best management practices by the individual. The amount of the credit cannot exceed $17,500 or the total amount of the tax imposed by this program (whichever is less) in the year the project was completed. This program can be used independently or in conjunction with other cost-share programs on the stakeholder's portion of BMP costs. It is also approved for use in supplementing the cost of repairs to streamside fencing.

Virginia Environmental Endowment – The Virginia Mini-Grant Program supports community-based efforts to strengthen environmental education and to promote stewardship of Virginia's waterways. Preference is given to modest local projects. Public and private schools (K-12) and nongovernmental, nonprofit community organizations in Virginia are eligible to apply for one-year Mini-Grant awards up to $5,000. Local, state, and federal government agencies and programs are not eligible.

Virginia Open-Space Lands Preservation Trust Fund – Farmland, forest land, and open space land are important to our heritage in Virginia. These lands are under increasing pressure from urban development in parts of the Commonwealth. The 1997 Virginia General Assembly created a new fund (Va. Code Sections 10.1801-2) to assist landowners with the costs of conveying conservation easements and the purchase of all or part of the value of the easements. The fund is operated by the Virginia Outdoors Foundation. Conservation easements preserve farmland, forestland, and natural and recreational areas by restricting intensive uses, such as development and mining, which would alter the conservation values of the land. An easement is a voluntary legal agreement between a landowner and a public body or conservation group in which the parties agree to protect the open-space and natural resource values of the land. Each easement is tailored to reflect the conservation values of the property

and is recorded in the local courthouse as a permanent part of the property records. Easements do not grant public access to a landowner's property. Costs that the fund may reimburse include legal costs, appraisal and other costs, and all or part of the easement's value. To be eligible, the easement must be perpetual in duration. Additional information is available at http://www.virginiaoutdoorsfoundation.org/VOF_land-ptf.php.

Virginia Small Business Environmental Assistance Fund Loan Program – The Fund, administered through VADEQ, is used to make loans or to guarantee loans to small businesses for the purchase and installation of environmental pollution control equipment, equipment to implement voluntary pollution prevention measures, or equipment and structures to implement agricultural BMPs. The loans are available in amounts up to $50,000 and will carry an interest rate of 3%, with favorable repayment terms based on the borrower's ability to repay and the useful life of the equipment being purchased or the life of the BMP being implemented. To be eligible for assistance, a business must employ 100 or fewer people and be classified as a small business under the federal Small Business Act.

Virginia Water Quality Improvement Fund – The purpose of the Virginia Water Quality Improvement Act of 1997 (WQIA) is to restore and improve the quality of state waters and to protect them from impairment and destruction for the benefit of current and future citizens of the Commonwealth of Virginia (Section 10.1-2118 of the Code of Virginia). The purpose of the fund is to provide water quality improvement grants to local governments, soil and water conservation districts and individuals for point and nonpoint source pollution prevention, reduction and control programs (Section 10.1-2128.B. of the Code of Virginia). Nonpoint source pollution is a significant cause of degradation of state waters. The Virginia Department of Environmental Quality (VADEQ) is responsible for administering point source grants and the Virginia Department of Conservation and Recreation (VADCR) administers nonpoint source grants. WQIF funds are provided, in accordance with the guidelines, to help stimulate nonpoint source pollution reduction through the Virginia Agricultural Best Management Practices Cost-share Program and water quality improvement projects. VADCR staff provides technical assistance, as well as financial assistance. During implementation in the RR watersheds, standards, specifications, cost-share, and tax credits for practices under the Virginia Agricultural BMP Cost-share Program will be followed for funding eligibility.

Wildlife Habitat Incentive Program (WHIP) – WHIP is a voluntary program for landowners who want to develop or improve wildlife habitat on private agricultural lands. Participants work with

NRCS to prepare a wildlife habitat development plan. This plan describes the landowner's goals for improving wildlife habitat and includes a list of practices and a schedule for installation. A 10-year contract provides cost-share and technical assistance to carry out the plan. Cost-share assistance of up to 75% of the total cost of installation (not to exceed $10,000 per applicant) is available for establishing habitat. Types of practices include: disking, prescribed burning, mowing, planting habitat, converting fescue to warm season grasses, establishing riparian buffers, creating habitat for waterfowl, and installing filter strips, field borders and hedgerows.

Wetland and Stream Mitigation Banking – Mitigation banks are sites where aquatic resources such as wetlands, streams, and streamside buffers are restored, created, enhanced, or in exceptional circumstances, preserved expressly for the purpose of providing compensatory mitigation in advance of authorized impacts to similar resources. Mitigation banking is a commercial venture which provides compensation for aquatic resources in financially and environmentally preferable ways. Not every site or property is suitable for mitigation banking. Wetlands and streams are complex systems, and their restoration, creation, enhancement, or preservation often requires specialized ecological and engineering knowledge. Likewise, the mitigation banking process requires experience to efficiently navigate. Mitigation banks are required to be protected in perpetuity, to provide financial assurances, and long term stewardship. The mitigation banking processes is overseen by the Inter-Agency Review Team (IRT) consisting of several state and federal agencies and chaired by DEQ and Army Corps of Engineers. For more information, contact the Army Corps of Engineers or VADEQ's Virginia Water Protection Program.

Wetland Reserve Program (WRP) – This program is a voluntary program provided through NRCS to restore and protect wetlands on private property. Landowners who choose to participate in WRP may receive payments for a conservation easement or cost-share assistance for a wetland restoration agreement. The landowner will retain ownership but voluntarily limits future use of the land. To be eligible for WRP, land must be suitable for restoration (formerly wetland and drained) or connect to adjacent wetlands. A landowner continues to control access to the land and may lease the land for hunting, fishing, or other undeveloped recreational activities.

REFERENCES

EPA-CBP. 2010. Agricultural BMP effectiveness estimates. Available at: http://archive.chesapeakebay.net/pubs/NPS_BMP_Table2.3.doc. Accessed: 30 August 2012.

Perciasepe, Robert. 1997. New Policies for Establishing and Implementing Total Maximum Daily Loads (TMDLs). Memorandum sent August 8, 1997. Washington, D.C.: U.S. Environmental Protection Agency.

SWCB (State Water Control Board). 2011. 9 VAC 25-260 Virginia Water Quality Standards. Available at: http://www.deq.virginia.gov/Portals/0/DEQ/Water/WaterQualityStandards/WQS_eff_6JAN2011.pdf. Accessed 30 August 2012.

Tetra Tech. 2003. A stream condition index for Virginia non-coastal streams. Prepared for USEPA, USEPA Region 3, and Virginia Department of Environmental Quality. Available at: http://www.deq.virginia.gov/Portals/0/DEQ/Water/WaterQualityMonitoring/vastrmcon.pdf. Accessed 30 August 2012.

VADEQ. 2006. Using probabilistic monitoring data to validate the non-coastal Virginia Stream Condition Index. VDEQ Technical Bulletin WQA/2006-001. Richmond, Va.: Virginia Department of Environmental Quality; Water Quality Monitoring, Biological Monitoring and Water Quality Assessment Programs.

VCE. 2000. Feeder and stock health and management practices, by John F. Currin and W. D. Whittier, Extension Specialists, Virginia-Maryland Regional College of Veterinary Medicine, Virginia Tech. Publication Number 400-006. January 2000. Available at: www.ext.vt.edu/pubs/beef/400-006/400-006.html. Accessed: 30 August 2012.

VCE. 1998a. Safe water for horses, questions about water testing, by Larry Lawrence, Extension Animal Scientist, Horses, Animal and Poultry Sciences, Virginia Tech. Livestock Update. December 1998. Available at: http://www.sites.ext.vt.edu/newsletter-archive/livestock/aps-98_12/aps-1005.html Accessed: 30 August 2012.

VCE. 1996. Controlled grazing of Virginia's pastures, by Harlan E. White and Dale D. Wolf, Virginia Cooperative Extension Agronomists; Department of Forages, Crop, and Soil Environmental Sciences, Virginia Tech. Publication Number 418-012. July 1996. Available at: www.ext.vt.edu/pubs/livestock/418-012/418-012.html. Accessed: 30 August 2012.

Zeckoski, R., B. Benham, and C. Lunsford. 2007. Streamside livestock exclusion: A tool for increasing farm income and improving water quality. VCE Publication No. 442-766. Virginia Cooperative Extension. Available at: www.ext.vt.edu/pubs/bse/442-766/442-766.pdf. Accessed: 30 August 2012.

APPENDIX A. GLOSSARY OF BMP AND OTHER CONTROL MEASURE DEFINITIONS

Alternative on-site waste treatment system: This practice is used to correct a malfunctioning on-site sewage disposal system or to replace an identified straight pipe in situations where the installation/replacement of a septic tank system cannot be permitted. Alternative systems may include the following: aerobic treatment units, low pressure distribution systems, drip distribution systems, sand filters, elevated sand mounds, constructed wetlands, peat filters, vault privies, incinerator toilets, and composting toilets.

Alternative water system: A structural practice that will provide an alternative water source for livestock to discourage animal access to streams. Cost-sharing and/or tax credits may apply to construction or deepening of wells; development of springs or seeps, including fencing of the area where needed, to protect the development from pollution by livestock; construction or repair of dugouts, dams, pits, or ponds; and the installation of pipelines, storage facilities, cisterns, troughs and artificial watersheds.

Barnyard runoff controls: This practice consists of gutters and downspouts to redirect runoff from heavy use area protection around a facility.

Continuous no-till system: Planting crops every year without disturbing the soil through tillage.

Cover crop: A fall-seeded grass or legume crop planted after the harvest of corn or soybeans to maintain a vegetative cover over the winter.

Critical area stabilization: Establishing permanent vegetation on sites that have or are expected to have high erosion rates, and on sites that have physical, chemical or biological conditions that prevent the establishment of vegetation with normal practices. This practice is used in areas with existing or expected high rates of erosion or degraded sites that usually cannot be stabilized by ordinary conservation treatment.

Fencing: A constructed barrier to livestock, wildlife or people. Standard or conventional (barbed or smooth wire), suspension, woven wire, or electric fences shall consist of acceptable fencing designs to control the animal(s) or people of concern and meet the intended life of the practice.

Hardened crossing: A controlled stream crossing for livestock and/or farm machinery in order to prevent streambed erosion and reduce sediment.

Improved pasture management: This practice consists of a series of measures to improve vegetative cover on, and reduce bacteria loading from, pasture areas and may include soil testing, application of lime and fertilizer based on soil testing results, maintenance of a 3-inch minimum grass height through the growing season except for droughts, mowing to control woody vegetation, and chain-harrowing to break-up manure piles after livestock are moved from field.

Livestock exclusion: Excluding livestock from areas where grazing or trampling will cause erosion of stream banks and lowering of water quality by livestock activity in or adjacent to the water. Limitation is generally accomplished by permanent or temporary fencing. In addition, installation of an alternative water source away from the stream has been shown to reduce livestock access.

Livestock exclusion fencing: This practice consists of installing fencing, both temporary and stream exclusion (permanent), for grazing distribution and to restrict stream access in connection with newly developed watering facilities. State and federal cost-sharing requires that the stream exclusion fence be placed a minimum of 35 feet away from the stream, except as designed in areas immediately adjacent to livestock crossings and controlled hardened accesses.

Livestock exclusion buffers: In the implementation plan, this term is used to differentiate the filtering benefits of the buffer, as opposed to the removal of livestock and their directly deposited bacteria loads from the stream. Removal of the livestock has an immediate effect in removing bacteria loads, while the buffer mitigates loading from surface runoff during storm events.

Loafing lot management system: This practice consists of preventing manure and sediment runoff from areas exposed to heavy livestock traffic from entering nearby water corridors and streams.

Reforestation of pasture or cropland: This practice consists of planting trees (hardwoods and/or conifers) on land currently used as cropland or pastureland in order to make a permanent land use conversion to forest, so as to more effectively control the soil and nutrient loss from surface runoff, thus improving water quality. As part of the practice, a permanent vegetative cover is to be established on gullied or eroded areas and shall be maintained until trees provide a protective canopy.

Riparian forest buffer: A protection method used along streams to reduce erosion, sedimentation, and the pollution of water from agricultural nonpoint sources. An area of trees and shrubs 35 – 300 feet wide located up gradient, adjacent, and parallel to the edge of a water feature.

Riparian grass buffer: Grass filter strips are vegetative buffers that are located along the banks of water courses to filter runoff, anchor soil particles, and protect banks against scour and erosion. The strips also improve water quality by filtering out fertilizers, pesticides, and microorganisms that otherwise might reach waterways. In addition, grass filter strips along streams serve as environmental corridors.

Septic system pump out: This preventative control measure consists of periodic maintenance of septic tank systems by having the tank pumped to remove solids and to inspect the septic tank. This practice also allows for the identification of systems which are not functioning properly. The practice also may include inspection of the distribution box to determine if the effluent is being properly distributed to the drainfields and the system is functioning in accordance to design.

Septic system repair: This measure consists of the correction of a malfunctioning on-site sewage disposal system to remove the presence of raw or partially treated sewage on the ground's surface, or in adjacent ditches or waterways, or in ground water.

Septic system, new: This control measure consists of the installation of a septic tank system to replace an identified straight pipe which delivers sewage directly to a stream, pond, lake, or river or an installation to correct a malfunctioning on-site sewage disposal system. Cost-sharing may include the pump out and removal of solids from the malfunctioning septic tank, the installation

of a septic tank and subsurface drainfield components, and the re-stabilization of disturbed areas by planting seed.

Septic system, new with pump: Same as for a new septic system, with the inclusion of a pump as a primary component to move waste to a higher elevation.

Sewer hookup, new: This practice consists of connecting a malfunctioning on-site sewage disposal system to public sewer, or replacing an identified straight pipe by a connection to public sewer. Cost-sharing may be authorized for the connection fee, which is the fee allowing the dwelling to be connected to the public sewer system, for the construction cost associated with connecting the dwelling to a sewer line, for re-stabilization of disturbed areas, and for the pump-out and removal of solids from the septic tank.

Water control structure: This practice consists of constructing detention or retention structures, such as erosion control dams, desilting reservoirs, sediment basins, debris basins, or similar structures that reduce the movement of sediment and other sources of pollutants from the land to the receiving stream.

APPENDIX B. BMP CODES AND PRACTICE NAMES

CP-21: CREP filter strip (rental only)
CP-22: CREP riparian forest buffer (rental only)
CRFR-3: CREP riparian forest buffer
CRSL-6: CREP stream exclusion
FR-1: Reforestation of erodible crop and pastureland
FR-3: Woodland buffer filter area
LE-1T: Livestock exclusion with riparian buffers
LE-2T: Livestock exclusion with reduced setback
RB-1: Septic tank pump out
RB-2: Connection of malfunctioning On-site Sewage Disposal System or straight pipe to public sewer
RB-3: Septic tank system repair
RB-4: Septic tank system installation/replacement
RB-4P: Septic tank system installation/replacement with pump
RB-5: Alternative on-site waste treatment system
SL-6T: Stream exclusion with grazing land management
SL-8B: Small grain cover crop for nutrient management and residue management
SL-10T: Pasture management
SL-15A: Continuous no-till system
WP-1: Sediment retention, erosion, or water control structures
WP-2T: Stream protection
WP-4B: Loafing lot management system
WQ-1: Grass filter strips